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THE DISTRIBUTION OF ELECTRICITY.

CONSIDERABLE activity appears to exist at the present moment in various parts of the globe amongst engineers who are striving to solve the problem of distributing electrical energy in a practical and at the same time economical manner. M. Marcel Deprez, in France, has been energetically labouring to overcome the electrical difficulties standing in the way of the transmission of motive-power; Messrs. Gaulard & Gibbs are indefatigable in their endeavours to bring their secondary generators into practical use, and now Herren Zipernowski and Déri come forward with another method of utilising induction coils, which has at least the merit of showing promise. The arrangements of all these inventors, however, are not yet far beyond the purely experimental stage, and there are obstacles inherent to all of them which cannot be overcome as they at present exist.

Leaving out of the question the special work of M. Deprez, the secondary generators of Messrs. Gaulard and Gibbs are dependent for their satisfactory operation upon the incessant and never-failing running of an alternating current dynamo, the continuity of their primary circuit or line—all their apparatus being arranged in series—and a given number of lamps in the secondary circuit. The transformers of Zipernowski-Déri appear to be an improvement upon the foregoing so far as the connecting up is concerned, but any accident to the dynamo will affect both systems in a like manner. That some means of storage is absolutely necessary to render the general distribution of electricity a *fait accompli* is now almost universally acknowledged, and we must perforce for this purpose fall back upon the secondary battery. Many there are who believe that these appliances will eventually force their way into universal use, but, on the other hand, there are yet a large number of persons who are incredulous regarding their lasting powers.

To the former class it must be a matter of more than ordinary interest to learn that a company in America uses, and successfully too, it appears, secondary batteries on a large scale for the distribution of electrical energy over a large area. The same kind of thing has been attempted in this country without success, therefore the doings of the Brush-Swan Company in the United States, particulars of which are supplied in another article, are all the more interesting.

We also observe that these batteries have been applied for the propulsion of tramcars with satisfactory results, as in our own country. It cannot be gainsaid, therefore, that we are on the eve of important developments in the application of storage batteries, and we hope that something may have been learned, which can be turned to good account, through the medium of the interesting correspondence which has recently been carried on in our columns respecting these but partly understood and partially developed necessaries.

THE CHARGE AND DISCHARGE OF ACCUMULATORS.

By MM. CROVA AND GARBE.

IN a previous communication * we have indicated the methods followed for the determination and the registration of the charge and the discharge of accumulators. We sum up in this note the results obtained by our method of registration.

As we have already stated before, we made use of the Planté accumulators as improved by Faure; each accumulator consists of twelve plates of 1·1 square decimetre each side, developing at each pole an active surface of 28·4 square decimetres.

1. *Phenomena observed during the charge.*—The strength of the charging current being considerable (12 ampères), the weight of the plates diminishes rapidly, but after a lapse of three hours a discharge of gas occurs at their surfaces; this discharge of gas does not indicate that the accumulator is saturated, for the inclined straight line which shows how the charging process is proceeding † begins now to be inflected, turning its concavity towards the axis to which it has a tendency to become parallel. It becomes then, as it were, shaky in consequence of the development of gas which communicates slight oscillations to the balance, and after the lapse of a comparatively long time (about eight hours) the line becomes straight again and parallel to the axis, thus showing that the charge has reached its limit; the total loss of weight corresponding with a complete charge amounted to 148 grammes.

The weaker the charging current is the later the gaseous discharge makes its appearance; with a constant charging current of 3 ampères the evolution of gas does not occur until the full charge has been reached.

The discharge of gas must be avoided as much as possible. It does, indeed, indicate a loss of energy not absorbed, and it contributes to the disaggregation of the active layer; for we may see brown flakes of binoxide and grey flakes of sulphate detach themselves from the plates and accumulate at the bottom of the containing vessel.

The strength of the charging current must therefore not exceed a certain value, which is that with which the discharge of gas does not occur until the plates have become saturated, that is to say, until they have ceased to diminish in weight.

2. *Phenomena observed during the discharge.*—The accumulator having been placed in circuit with a known resistance, a uniform current is set up almost immediately, the strength of the current varies scarcely from the moment of the closing of the circuit, and rapidly attains a remarkable constancy; the registering apparatus describes now a straight line, which is the more inclined to the axis of the abscissæ as the current is more intense.

After the lapse of a certain time, which varies with the strength of the discharging current, the straight line becomes rapidly inflected, the yield diminishes suddenly, and the registering apparatus describes a line much less inclined, which finally degenerates into a very long curve, which shows a tendency to become a straight line parallel to the axis of the abscissæ; the accumulator is now almost completely exhausted.

The second discharge, feeble and inconstant, cor-

* *Comptes Rendus* and ELECTRICAL REVIEW.

† This line has for axis of the abscissæ the axis of the times, and for axis of the ordinates the variations of the weight of the accumulator.

responds with a fraction, practically useless, of the charge. The greater the strength of the discharging current the more inclined and shorter is the straight line which represents the practically useful and constant yield, and the longer is also the duration of the residual discharge corresponding with a low potential. After a powerful discharge of 8·4 ampères of only three hours duration, the weak residual discharge lasted 115 hours and represented five-eights of the total charge ; a fraction, three-eights, of the total charge only having been utilised. In this case it was necessary to recharge the accumulators in order to saturate them again without attempting to utilise the residual charge, but then the state of affairs had the appearance as if the capacity of the accumulator was reduced to a fraction, which becomes smaller as the strength of the discharging current increases. The weaker the discharging current is, the more constant it will be. With a discharging current of 3 ampères, we obtained a constant yield which lasted over 15 hours. In this case two thirds of the total charge was utilised ; with a still weaker current the useful yield would be greater still.

During the intense discharge the chemical action is confined to that part of the active layer which is in immediate contact with the lead ; if the current is weak the chemical action has a tendency to equalise itself within the body of the active layer ; the stronger the current is, the more the layer of sulphate formed at the points of contact between the active layer and the lead tends to separate the former from the latter.

Therefore, if we, after having established a certain flow of current, interrupt the circuit we shall see that the balance describes no longer a straight line parallel to the axis of the times, which would indicate the invariability of the weight of the plates, but an ascending curve which only slowly tends to become parallel to the axis. It will be seen that, under those circumstances, sulphate continued to be formed in the accumulator for some time after the circuit was interrupted, thus showing that although no current is flowing, yet reactions occur within the substance of the active layer between the lead, the sulphate formed, the remaining binoxide, and the free sulphuric acid.

3. *Phenomena observed whilst the circuit is open.*—Our method of registration has even enabled us to continue the study of the accumulators whilst the circuit remains open. In that case the registering apparatus describes a straight line parallel to the axis of the times, thus indicating that the accumulators retain their charge without the occurrence of any waste of energy or of material.

However, if we, after having charged the accumulators by means of a powerful current, whilst an abundant and prolonged evolution of gas has taken place, leave the circuit open, the balance will indicate a very slow and relatively small increase of weight (5 grammes), the voltmeter will at the same time show that the potential, which was 1·92 volt at the outset, slowly decreases to 1·87 volt and then remains constant. This is probably due to the action of the gases retained in the active layer. After some short time the accumulators finally attain a constant weight and potential. This constancy of weight and potential was maintained throughout the duration of the registration (40 hours).

Conclusions.—The potential corresponding with the mode of charging is constant as long as the registering apparatus describes its inclined straight line. The discharge of gas is not an indication of saturation, but of loss of energy and of damage to the active layer, which occurs all the sooner before the completion of the saturation, as the charging current is more powerful.

The rapidity of the yield has for result a diminution of the practically useful capacity ; the chemical action consequent on the interruption of the circuit can produce no useful effect after the uniform flow of current, for the current, energetic as it may be at the moment of the re-closing of the circuit, falls rapidly in strength, and becomes almost as soon exhausted.

Thick layers of active matter are only then useful when the current, calculated per unit of surface, is sufficiently weak, say about 0·1 ampère per square decimetre of active surface, it is therefore advantageous in the case of a powerful current being required, to enlarge the surface of the plates so as to be able to work with active layers of relatively small thickness. The limits to which that thickness may be usefully increased depend on the current strength per unit of plate surface, and, probably, also on the constitution of the active layer, which varies with the mode of its construction or formation.—*Comptes Rendus.*

THE ZIPERNOWSKI-DÉRI SYSTEM OF DISTRIBUTING ELECTRICITY.

[A COMMUNICATION.]

(*Continued from page* 95.)

The experience gained in the field of electric lighting with the different systems of current distribution at present followed, has established the fact that extensive installations of illumination by incandescence can only be rationally carried out and worked successfully when all the lamps are joined up in parallel circuit and are fed with equal and constant current strength. The same condition also obtains when transformers are used for working incandescence lamps in parallel circuit, and, as $R\,i_2$ remains a constant factor, we draw from the above deduction the following rule :—*that the difference of potential between the primary terminals of the transformer must remain unchanged.*

If two or more transformers are to be fed by one and the same primary current, it will be absolutely necessary, if a satisfactory illumination is to be maintained, that those apparatus are perfectly independent of one another in their respective external circuits ; in other words, *changes in the circuit of one apparatus must in no way affect the other circuits.* The fundamental principle of the systems of Gaulard and Gibbs is, that the alternating currents from the dynamo machine pass through the primary spirals of all the generators in succession and then return to the machine, thus tending to maintain a constant current in the primary circuit. The secondary spiral of Gaulard's generator is treated as a separate source of current, and there will consequently be as many secondary circuits as there are apparatus. If, now, in those circuits incandescence lamps are to be worked in parallel circuit, all the lamps must be kept in action, for the cutting off or joining in of lamps would have a disturbing influence on the remainder, or might even affect them dangerously. If we would effect the cutting out or joining in of lamps in any one secondary circuit by a corresponding decrease or increase of the primary current, the result of this regulation of the current would be to similarly affect the other generators and their external circuits, so that changes made in any one circuit will affect the intensity of the light of all the lamps in the whole central installation.

From what we have advanced, it is clear that the system we briefly described as unsuitable for general lighting purposes, is especially so for the general lighting of towns. The Zipernowski-Déri system insures the complete independence of each lamp from all the others. That system is based on constant difference of potential, and the above-mentioned electricians have elaborated different methods from which the following rules may be deduced :—The primary spirals of the transformers which form a single secondary circuit may be joined up in various ways, in parallel, singly, or in series of groups. Both ends of the primary spirals of such a group must, however, be connected with the dynamo machine circuit, which has a constant difference of potential in such a manner that the different groups are joined up parallel in the primary circuit.

At the primary terminals of such a group which represents, as it were, a distribution station of the second class, *the difference of potential is always constant,*

whilst the strength of the current in the branch circuit varies with the number of lamps in the secondary circuit. The energy expended remains, therefore, tolerably proportional to the quantity of electricity consumed by the lamps, &c. The fundamental condition of the Zipernowski-Dèri system is then, that the difference of potential of the primary current at the terminals of the transformer or of the group of transformers shall remain constant, although the quantities of current in the respective circuits vary continually, thus totally differing from the methods at present in use, which are based on the principle of the constancy of the *strength of the primary current.*

The new arrangement resembles the action of the so-called compound dynamos between whose pole terminals a constant tension is likewise maintained, when single lamps are either cut out or switched in. It is far more difficult, when using alternate currents, especially when they are of high tension, to arrange for the difference of potential remaining constant at a distance of several kilometres from the dynamo machine. This problem has been solved in the following simple manner :—It is well known that with a constant number of revolutions of the dynamo machine its E.M.F. remains constant, provided the magnetisation remains the same. The difference of potential is, however, generally different from that E.M.F., that is to say, that in comparison with the latter it decreases with the increase of the current, because the internal resistances of the dynamo machine as well as the resistances of the circuit tend to cause a decrease of difference of potential, which becomes greater with the increase of the strength of the current consumed. If we now desire to maintain a constant difference of potential at different points of the circuit, we must render the E.M.F. of the dynamo machine, even when it is running at a constant speed, variable in the opposite sense as the external resistances. We cannot then have a constant magnetic force, but one which grows in the same sense as the intensity of the primary current.

For this purpose we introduce in the exciting current circuit a second source of current whose E.M.F. is added to that of the original exciting circuit. This second E.M.F. is not constant, but is directly dependent on the principal current and, as near as possible, proportional to it. This indispensable, variable, regulating E.M.F. is produced by a small transformer, called a compensator, which is placed near the machine which generates the current. This compensator has two spirals, through one of which the principal current flows, whilst the other is connected with the circuit of the exciting circuit. In the latter is induced in this way an alternating current whose E.M.F. depends on the intensity of the inducing principal current (primary current).

For this regulation Ganz and Company's machines, which are known under the name of self-exciting alternate current machines, Zipernowski-Déri system, are especially adapted. A type of those machines is represented in fig. 7. It is a machine with 18 magnet poles and yields from 50,000 to 60,000 watts. In these machines the magnets rotate, whilst the coils in which the principal current is induced are fixed, and that current is led off from fixed terminals. The commutator serves to turn a small portion of the induced current, in a very peculiar manner, in one direction, and then to use it to excite the magnets. In the latter circuit the second spiral of the compensator is introduced in such a manner that its E.M.F. increases the tension at the brushes of the commutator in the same proportion as the strength of the principal current grows, that is, as the number of lamps in action, &c., increases in the secondary circuits.

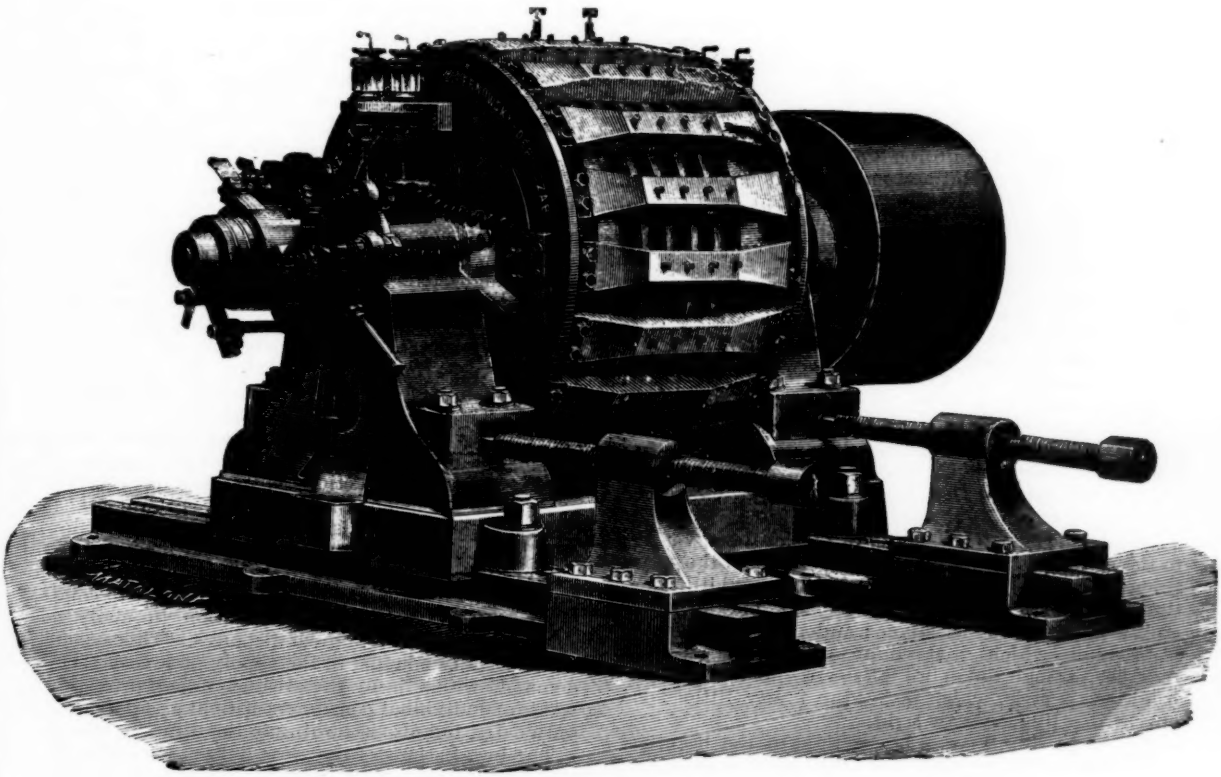


FIG. 7.

The inventors also apply this method of regulation, according to circumstances, to generators with alternate currents, which are separately excited ; the exciting current is even frequently generated by transformers, and several variations of this system of regulation could be mentioned which all fulfil the requisite condition, and that without the medium of variable resistances, of automatic mechanisms, or of mechanisms moved by hand ; a constant difference of potential is

maintained from the moment the primary current enters the transformers.

The here-described different constructions, arrangements, and methods of regulation, which together form the system of the distribution of electricity of Zipernowski and Déri, form as it were the links of a chain representing a uniform system of distribution of electrical energy especially for lighting purposes, which fulfils all rational requirements to a degree not hitherto attained. The distribution and regulation of the current has been effected with the greatest simplicity and in a perfectly reliable manner; by employing high tensions the erection of the network of conducting wires is rendered comparatively cheap, whilst the use of the converted current of very low tension for the illumination of dwelling houses, other establishments, and streets, is absolutely free from danger.

This system of current distribution has been carried out at the Buda-Pesth National Exhibition to a tolerably great extent. Messrs. Ganz and Co. have erected there a central station from which the primary current is led through copper wires of 4·5 mm. diameter to a maximum distance of 1,300 metres, to actuate the transformers which feed the lamps in the different secondary circuits. The total number of those incandescence lamps amounts to 1,067, which are divided into seven groups or stations. This model installation has been in action since the beginning of May, and gives the best results.

At the National Exhibition the electric light has been utilised in a very prominent manner. It has rendered signal services already during the period of installation, in so far that during the fortnight prior to the opening of the exhibition, such works in and outside the industry building as were in arrear could be, thanks to the electric light, continued during the night; and it is partly owing to that circumstance that the Buda-Pesth National Exhibition, thus favourably contrasting with its predecessors, gratified the numerous visitors on the opening day by its forward state of readiness.

In addition to this provisional installation, very important, and, in many respects, very interesting installations of arc and glow lamps have been carried out for the duration of the exhibition, which were likewise in action on the opening day.

On turning into the Stefanie Strasse at dusk, visitors to the exhibition are agreeably surprised by the truly splendid effect of the so completely successful illumination of that street. The arc lamps fixed on tall masts emit a light as clear as silver; and marvellous is the impression which that light makes shedding its radiance through the dense foliage of the trees on the bright grass plots, which makes the pretty little wood appear in a literally new light.

Nor is the illumination by arc light of the beautiful principal entrance to the National Exhibition park, and of the park itself, less effective. On entering it we have at once the opportunity of becoming acquainted side by side with the powerful arc light, with that ideal of modern domestic lighting, the so-called glow light, as shown in the two elegant beer saloons on both sides of the principal entrance, in the model hotel, and in other localities of the exhibition.

We will now mention here the localities electrically lighted :—

I.—*Arc Lamps.*

Stefanie Strasse and plantation ...	45	arc lamps.
Exhibition Park	30	„
Engine room	3	„
Ganz's Pavilion	5	„
Boiler shed	1	„
Outside the restaurant of the Beer Brewery Company	3	„
Dreher's Restaurant	6	„
Turkish coffee house	3	„
Littke's Pavilion	1	„
Total	97	„

II.—*Glow Lamps.*

Restaurant of the Beer Brewery Company	200	glow lamps.
Dreher's Restaurant	180	„
Törley's Pavilion	12	„
Model hotel	175	„
Four stables	60	„
Total	627	„

Those installations were made by Messrs. Ganz and Co., as well as two larger installations in the exhibition, namely :—

1. The panorama with 16 arc and	140	glow lamps.
2. The concert hall with ...	300	„
Total ... 16 ...	440	„

So that that firm has supplied the Buda-Pesth National Exhibition with no less than 113 arc and 1,067 glow lamps.

These figures show that electricity is represented at the Buda-Pesth National Exhibition by such an imposing quantity of light as has never (not taking into account the special electrical exhibitions of the last two years) been, even approximately, equalled in any other exhibition; and we may say with satisfaction that this latest produce of modern lighting technics is most grandly represented at the Buda-Pesth National Exhibition. It is not solely on account of the splendour with which this branch of industry is represented that the Buda-Pesth exhibition is so particularly interesting, but more especially in consequence of the fact that a new system of distribution of the light has there been inaugurated, which, according to the experimental results obtained, bids fair to mark an epoch in the history of the electric light, as being calculated to overcome all the obstacles which thus far hindered, or in many cases rendered impossible, the establishment of central stations for the electrical illumination of towns. This system is based on the use of induction apparatus as the current distributing medium between the generating dynamo machine and the lamps. The function of those induction apparatus is to convert currents of high tension, which can be easily and cheaply conducted over great distances, into currents of low—absolutely safe—tension, as is essential for the illumination by incandescence of dwellings and other establishments. In this way it becomes possible to conduct the current from one central station to many consumers, even over very great distances. This system is also specially adapted to the supply of a very variable demand, which is of the greatest importance, as the wants of individual consumers of light greatly vary, not only daily, but also according to the different seasons.

The installations of the glow light at the Buda-Pesth exhibition form an interesting example of the Zipernowski-Déri system of arranging a central station for the illumination of several establishments at different localities of a town.

The central station is located in the engine room at the corner of the Herminen Strasse and the Stefans Weg, at the south-east end of the *locale* of the exhibition. It consists of a self-exciting alternate current machine (Zipernowski-Déri patent) capable of feeding 1,200 glow lamps, driven by a Láng steam engine by means of intermediate gearing.

Two uncovered copper wires, of the thickness of ordinary telegraph line wire, lead from the terminals of the dynamo machine along the roof of the international engine room, and thence on telegraph poles with insulators along the Stefanie Strasse to the model hotel, situate in the neighbourhood of the industry hall, a distance of 2,200 metres.

From this line other lines branch off, namely, one for the illumination of the concert hall, and a second one leading from the corner of the Stefanie Strasse to the restaurant of the Buda-Pesth Brewery Company. There is a third branch near the police station leading to Dreher's restaurant, and in the immediate vicinity

of this branch there is another branch which leads to the panorama.

In the erection of the primary line care has been taken, by rising poles of a suitable height, to render the wires inaccessible to the public.

In the induction apparatus, the so-called transformers, the conversion of the current, as we have already described, takes place. In the secondary circuit are introduced the several localities which are to be lighted. From the secondary line leading to different localities branch lines can be led to other localities near the former; for instance, from the secondary line leading to the model hotel a branch line goes to Törley's pavilion, 40 metres distant, where it feeds an elegant lustre of 12 glow lamps, whose clear and rich light enhances the effect of the tasteful arrangement of that establishment.

In electrical circles, the invention of which we have here given a description has already met with due appreciation, and several of the most eminent foreign electricians, and delegates of a large foreign town, have signified their intention of submitting on the spot to a thorough and critical test the practical application of this most important system.

As we have already pointed out, the Buda-Pesth National Exhibition furnishes the practical demonstration of a very ingeniously elaborated system of the electrical lighting of towns, a system which fulfils all the essential conditions; and we may confidently expect that, in consequence of the considerable advantages of that new system, it will soon become universally known and widely adopted.

AN ELECTRICAL CRANE.*

By HIPPOLYTE FONTAINE.

THE Compagnie Electrique, which possesses the exclusive right of working the patented Gramme machines for the transmission of power, has effected several highly interesting installations. We mention among others the apparatus for ventilation of the Town Hall of Paris and the new Central School of Arts and Manufactures, the drawbridges of the works of M. Marinoni at Paris, a series of domestic appliances devised by M. Dagnin, and at work in the well-known restaurant of M. Marguery, and a foundry crane in the establishments of M. Joseph Farcot, at Saint-Ouen.

We will commence by giving some particulars concerning M. Farcot's crane, so that our readers may fully understand the advantage resulting from the use of electric machines in appliances for raising weights.

This crane before its transformation was worked by hand, and generally required ten men when it was necessary to deal with heavy pieces, which occurred several times daily. These ten men were not even sufficient to secure regularity of service, so that the space served by the crane was almost always much encumbered. Since the addition of the Gramme machine there is a complete change. One man suffices for the service, the speed of lifting is more than doubled, and the space is to a great extent kept clear, thus rendering it possible to work more safely and more methodically.

A Gramme machine of 4 horse-power is fixed upon the two lower cross-pieces of the crane, and a rheostat corresponding to a resistance of 50 ohms is placed immediately above the Gramme machine. The original movements have not been suppressed; on the contrary, the Compagnie Electrique have arranged a movement by which it is possible to pass instantly from electric working to working by hand, in case the steam engine which drives the generating Gramme machine should be out of order. A Mégy brake limits the speed of descent, and renders the service absolutely safe. This ingenious brake works equally well to the right or the left. A commutator serves for starting, stopping, and regulating the speed. For this purpose it has a series of contacts for introducing into the circuit greater or smaller resistances. Two pinions set in action two toothed wheels of different diameters, and give the option of working at different speeds, according to the weight to be raised.

The Gramme machine which generates the current is placed in an engine house at a distance of about 90 metres from the crane. It has a speed of 1,550 revolutions per minute, and yields a current of 13 ampères, the difference of potential at the terminals being 250 volts. The conductor which connects the two dynamos is composed of seven copper wires of 1·2 millimetres in diameter, covered with an insulator. The recipient Gramme machine makes 1,000 rotations per minute. A train of wheel-work renders it possible to pass from this speed to 2·5 rotations of the drum for rapid work, and 0·9 rotations for slow work.

Thus the conversion merely required two Gramme machines, a rheostat of 50 ohms, a double conductor of 90 metres, a Mégy brake, and a few accessories of little importance. In the present case the outlay for a 20-ton crane has not exceeded 6,500 francs, and the actual work of the crane has been more than doubled.

M. Joseph Farcot (whom we must congratulate on taking the lead in applying in his beautiful establishments at Saint-Ouen all the progress which has been manifested in the mechanical industries) drew up a complete programme of conditions for the Compagnie Electrique for the conversion of his crane.

1. The crane must be able to raise 6 tons at a speed of 1 metre per minute, or 20 tons at ¼ metre per minute.
2. The speed in descending must not exceed 1·20 metre per minute for 6 tons, and 0·30 metre for 20 tons.
3. It must be possible to revert instantly from electric power to manual labour.
4. There must be a safety apparatus preventing any acceleration during the descent.
5. The radiating movement must be governed by electricity.

After three months of daily use the transformed crane has been formally accepted, and its results are admitted as follows:—

The recipient Gramme machine can develop work of 330 kilogrammetres, say 4·4 horse-power. The yield between the shaft of the generating Gramme machine and the shaft of the recipient is 65 per cent. The yield of the crane between the shaft of the recipient machine and the hook is 38 per cent.

At the higher speed 6 tons can be lifted at 1¼ metre per minute. At the lower grade a load of 20 tons is lifted at the rate of 0·35 metre per minute. The lowering of the loads is 1—19 that of the raising.

The problem set has therefore been entirely solved.

We have still to call the attention of our readers to an important detail. It is a reversing commutator used for the first time for the purpose of changing the direction of the movement of the recipient Gramme machine, according as it is required to raise or lower a weight. It is an industrial modification of Bourseuil's apparatus, well known in telegraphy, only in place of the two hooks which make a metallic connection sometimes between two segments and sometimes between the other two, the communications are made by means of two contacts, insulated from each other and fixed upon an oscillating transverse cross-piece. A single operation suffices to change the direction of the current in the bobbin without changing it in the electromagnets. A change is thus effected in the movement without its being necessary to cause the brushes to make a complete revolution, *i.e.*, without putting each of them in the place occupied by the other. Nevertheless, if the brushes remained fixed they would no longer be in the best position of equilibrium, and numerous sparks would be produced. The new improvement introduced by M. Nysten, of the Compagnie Electrique in changing the movement devised

* *Revue Industrielle.*

by M. Gramme, is to effect in a single operation the change of the direction of the current in the bobbin, and the rational displacement of the brushes. The apparatus is simple and it acts very well.

A final remark deserves to be submitted to persons who criticise the *yield* of electric transmissions. M. Farcot's crane, worked by manual labour, required daily an average expense of 30 francs. With electricity this outlay is reduced by more than three-fourths. In face of this result, which is met with in almost all the installations carried out by the Compagnie Electrique, it is really childish to discuss the yield, properly so-called. If a transmission expends 35 or even 50 per cent. of the initial work, this does not practically affect the industrial result. We consider that the use of electricity gives a yield superior to that obtained by any other system of transmission ; but we insist upon the trifling importance of this yield in current applications.

MEASURING THE RESISTANCE OF HEATED CONDUCTORS.

RECENTLY various attempts have been made to determine the relation of the strength of a current to the diameter of a conductor for a given degree of heating. This object has been aimed at in different manners. The increase in the temperature of the conductor was determined by means of a calibrated thermo element, or from the increase of resistance as measured with a Wheatstone bridge ; or by the increased resistance of a platinum wire coiled spirally about the conductor, or its expansion was taken as the measure of the increase of temperature.

In experiments in this direction which I (Herr T. Marcher in *Zeitschrift für Elektrotechnik*) conducted for the firm of Siemens and Halske, I constructed a modification of Thomson's double bridge which for the measurement seems to me preferable to the methods above mentioned as, in addition to its great simplicity, it permits a measurement of the resistances of the conductor and of the currents which heat it. If a mirror-galvanometer is employed, the degree of accuracy can be selected at pleasure. Whilst retaining the valuable property of Thomson's double bridge, as modified by Kirchhoff and Hansemann, *i.e.*, the measurement is independent of the resistances of the leads which are connected between the resistances to be measured and those parts which convey the current. (Fig 1 is a diagram of the course of the current in Siemens and Halske's bridge, as shown in fig 2, for the measurement of very small resistances). The arrangement was adopted that instead of the measuring wire, N, there was introduced a fixed resistance which did not become heated by the passage of the current. The compensation was effected by the resistances in the branches of the bridge, R and R′. If $\frac{o}{p} = \frac{n}{m}$ signifies the relation of resistance of these branches, and M the resistance to be measured, and if R = R′, there will be no current in the bridge if

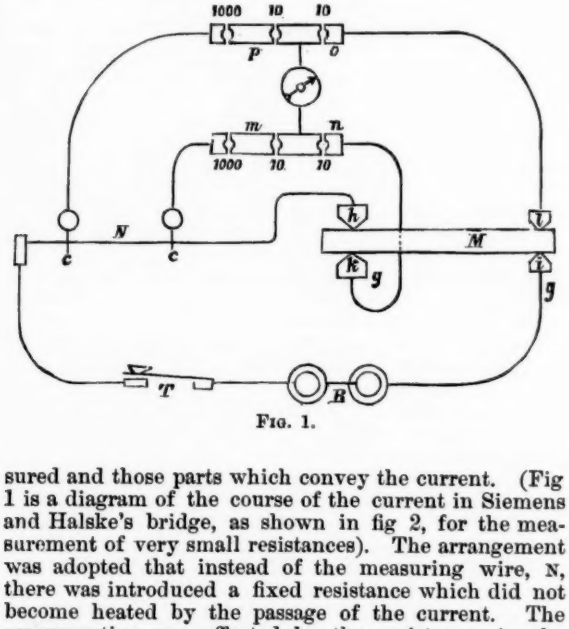


FIG. 1.

$$M\,m = N \times R \times n,$$

whence

$$M = \frac{N \times R \times n}{m}$$

In accordance with the circumstance that with great resistances slight currents come into play, and with small resistances, intense ones, when, *e.g.*, the resistance of a glow lamp in a hot condition or the increase of temperature of a portion of conductor is measured, the standard resistance N is selected.

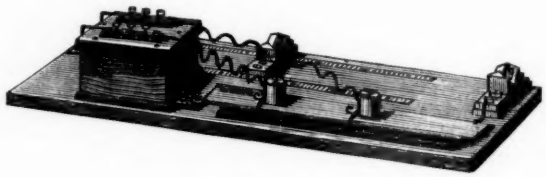


FIG. 2.

If we have to measure the increase of temperature of a cable of 200 square millimetres section, through which passes a current of 500 ampères, we should take for N = 0·001 of 800 square millimetres section ; but in measuring the resistance of a glow lamp we should put N = 0·1 of 5 square millimetres section. If both these resistances are at our disposal and if $R = R_1$ extends from 1 to 500, we can measure within the following limits :—

(*a*) N = 0·001

$$\frac{n}{m} = \frac{1}{1}\ ;\ M = 0{\cdot}001\ R_1$$

$$\frac{n}{m} = \frac{1}{10}\ ;\ M = 0{\cdot}0001\ R.$$

$$\frac{n}{m} = \frac{1}{100}\ ;\ M = 0{\cdot}00001\ R.$$

(*b*) N = 0·1

$$\frac{n}{m} = \frac{1}{1}\ ;\ M = 0{\cdot}1\ R.$$

$$\frac{n}{m} = \frac{10}{1}\ ;\ M = 1\ R.$$

SECONDARY BATTERIES FOR ELECTRICAL DISTRIBUTION.

IN our last week's issue we published the directions of Mr. Roberts, of the Brush-Swan Electric Light Company, of Cheyenne, Wy., for erecting and maintaining storage batteries. These were taken from a paper read by that gentleman before the American Institute of Electrical Engineers on the 20th of May last, and from which we learn that the above-named company was formed in the fall of 1882, and being the first to use Swan lamps in conjunction with the Brush storage battery and arc system. These batteries were put in operation early in 1883, and, at the date of Mr. Roberts's paper, 99 batteries and 1,500 lamps were in operation. These were distributed over an area of about one mile square ; the charging station for the batteries being about one quarter of a mile outside the north-west corner of the square, and over 300 of the lamps being in the south-east corner. On each block—sometimes on every two blocks—is located

a small *portable* house in which are placed all the batteries furnishing the current for the said block. An extra battery is kept in each house for use in case more light is required. Three sizes of batteries are employed with capacities of 20, 40 and 80 lamp-hours respectively. The charging circuits are three in number; two to private residences where Nos. 1 and 2 batteries are used, charged from 7 a.m. to 1 p.m. with a 10 ampère current, and one circuit to the business part of the city where No. 3 batteries are employed. These being much larger, are charged from 7 a.m. to 3 p.m. by a 65-light dynamo; this, unfortunately, does not give us much information. At dark, the charging circuit is looped in with the all-night outside arc circuit, and this, by connections for quantity, controls about 50 batteries; thus they are left until daylight, when the arc circuit is shut off. By this means the batteries obtain considerable charge; they are then disconnected and charged separately during the day.

The reading of this paper was followed by a discussion, from which, although but little that is new can be gleaned of a technical nature, we abstract the following remarks. For a full report of the proceedings we must refer our readers to the New York *Electrical World*.

DISCUSSION.

The CHAIRMAN (Mr. Frankland Jannus): The subject is now before you, gentlemen. Mr. Roberts is especially prepared to answer questions in regard to the practical operation of such a plant.

Prof. ANTHONY: I would like to ask Mr. Roberts what his experience has been in regard to the durability of the lead plates.

Mr. ROBERTS: We have been running since the early part of 1883, so that we have had a fair experience; but what the plates will do at the present time it is hard to say, because they have improved so much. At first there would be six cells in one long box, the wood of which was all continuous. The plates did not have room to expand and they were not as good, and we did not know how to attend to them as well. But we have had better plates running for over a year in those batteries which do not show any sign of disintegration. Our experience in learning what to expect and what not to expect has been of great value, as we are enabled to attend to every little matter before it goes far to the bad. It is hard to say what the most recent batteries will do. I could say as to one year well enough, but I would not like to say as to three or five. In this Brush battery, you know, the cell —the positive—is a gridiron in shape, having corrugated ribs between two negatives, and the distance at first used to be very small; I think it was three-eights of an inch. The idea, of course, at first was to get the resistance as small as possible, but I don't think that practice made much difference there. At first there was great trouble from short circuiting; a rib, sometimes at first, would gradually become oxidised around under the rib, and the top part would fall over and hit against the negative.

Mr. HALL: That occurs especially at the bottom of the cell?

Mr. ROBERTS: If the sediment collected sometimes it would occur right at the top of the cell. But now they have room to expand with the present battery.

Mr. HALL: Have you ever had any opportunity to observe how the electromotive force of the cell fell off if it were not used immediately after charging?

Mr. ROBERTS: My paper, of course, is not one of scientific figures. Nevertheless my directions for using storage batteries show that it is advisable to have them charged and discharged every day. Of course it does fall off, and for that reason I say discharge every day.

Prof. ANTHONY: In charging, are the indications of the manipulator followed, or some other plan?

Mr. ROBERTS: As a general thing we charge according to the manipulator, which is the time of charging the battery, and which bears a very close relation to the time of discharge, when they are properly arranged. We had a great trouble at first in doing that, until we introduced this storage battery-house system. Each man has his battery in that place. He is independent as far as he is concerned. This man keeps a constant eye and tells by observation, without the strain of thinking—at least he notices—if a battery takes much longer to charge than is usual. Then he tests that battery, running over each cell with a wire, and if everything seems all right, why it is supposed the consumer uses that quantity. If he finds anything wrong, why then he makes a note of it in a paper that hangs up in the battery house. If there is any large change—if a man's bill had been running six or seven dollars a month and we find it is 20 or 30 dollars, we pay attention to it; but that does not often occur. And so I think we can safely say that the time of charging is the means that we employ to charge our customers, and it is a satisfactory means, too.

Mr. F. L. POPE: It seems to me that we can see very plainly from Mr. Roberts's paper that a large share of his success is due to his system of placing the plant in charge of trustworthy and intelligent employés. This is a matter that is getting to be altogether too much overlooked of late years. It is getting to be quite a common practice with electrical companies to draw up a code of strict rules and regulations, mainly theoretical, and then find somebody who will work for four dollars a week to carry them out, and in case of failure, pretty nearly everybody but themselves is blamed. If anything goes wrong with a battery, and there is anybody who understands it to attend to it, it is rectified in a moment. If it is allowed to go on, it results in considerable damage.

Mr. ROBERTS: One of our best men had been an electro-plater and manufacturer of electrical instruments, and our foreman of battery work has been a telegraph lineman. What we intend to do is to pay good wages, and if a man does not come to time, turn him out. We are pretty strict about that, and the consequence is we get fairly good service. But the men who attend to the batteries and who do the most work about them are not what you would call skilled labourers. I have every man, as far as possible, responsible for the work under him. Many of them take considerable pride in it, and are badly hurt if things do not go right.

Mr. F. L. POPE: As I understand Mr. Roberts, he does not pretend to compete with the commercial price of gas. It is evident that he is proceeding on a more business-like principle than a great many in that business.

Mr. ROBERTS: The gas company started after we did. The two principal men in the electric light company and in the gas company have been opposed in politics and stocks and everything else out there, and whenever one starts a thing the other starts something else in the same line. Our first batteries were very defective batteries. We did not know how to handle them. A party would be given by one of our customers, and suddenly the lights would go out. The gas people saw an opportunity and the company was started. I favoured sticking to our price until we found how the gas company came out, because it is a good deal harder to raise your price after you have once dropped it than to stick to your price. We stuck to our price and got orders right along, so we stayed there.

Mr. F. L. POPE: I think that is a cardinal mistake that has been made from the beginning in the electric light business, to endeavour to compete with gas in the matter of price when every well-informed electrician has been perfectly well aware from the beginning that in the present state of knowledge it was not possible to do it, and for that reason the attempts which have been made to furnish house-to-house lighting from central stations have not, I think, been commercial successes, as far as my knowledge extends. Now it seems Mr. Roberts has adopted a very intelligent plan in his operations. Where he can use direct lighting he is doing it. Where direct lighting cannot be used commercially he is using something else. He is adapting his methods to the place where they are to be employed, and he is endeavouring to charge a price which will give him a fair profit on what it costs him to do it, irrespective of whether the gas costs less or more.

Mr. ROBERTS: I intended to mention, when I was speaking before, that we are promised some glass cells. We are not using them yet, but their use will prevent cells short-circuiting by one touching the other, and it will prevent the creeping largely on the edge, which is also bad, and we shall also be able to see down, particularly if we put an incandescent light behind the reflector, and see what the condition of the plate is.

Prof. ANTHONY: I heard something about a company that made glass cells about a year ago, and I was anxious to know if they had been tried and what their success was.

Mr. ROBERTS: I only know from hearsay, and that is what Mr. Potter told me in Cheyenne. I do not remember where he said they were used, but they were working well.

A MEMBER: We use glass cells for secondary batteries. We used wood boxes, but we found that after a month or so they began to leak, and they made some stronger boxes, and the last were made of glass, and now all the cells are made of glass. They put India rubber between the plate and the glass; that is, as we use it in Europe.

Mr. ROBERTS: Those strips must be in the liquid. The liquid must go to the glass. Therefore those strips could hardly be insulators. They could only be used to keep the cells in position.

A MEMBER: The strips are on the outside, and inside there are only pieces.

Mr. THOMPSON: How are those joints made in the cells? You say they leaked a little at first, and then they did not leak. I made a lot of cells by flattening the lead and cutting it in certain directions, so that when folded up it makes a complete box; then by taking a Bunsen burner flame and getting a little, sharp flame, and teaching the mechanic, he could run the flame along slowly and form lead boxes. About two years ago I saw some of the Brush cells. They were simply soldered. I tested one and it was leaking. Some would last for a long time, because the acid attacking the solder would take a long time to eat through the solder, the solder being placed on the outside and the acid attacking only a very small area of the solder at once. I was wondering how they were made at present, and would add that all lead vessels for containing acids may be constructed as easily by melting the joints with a Bunsen burner gas flame as by solder.

Mr. ROBERTS: The way they are made of course I do not know, because we get them from the Brush company. I presume they make a burnt connection. There is no solder used. It is all lead and fused together.

Mr. G. A. HAMILTON: In this particular plant about what percentage of the charge is returned? I should be very glad if Mr. Roberts could give us any information in regard to this.

Mr. ROBERTS: I have said that my paper is not one of figures, and therefore I do not feel quite ready to answer questions respecting matters of that kind. The Brush Company reported 75 per cent. as the efficiency, and I do not see any reason to doubt it. It depends very largely upon the conditions. There was one remark made a little while ago to the effect that the expense of running depended somewhat upon the labour and the amount of lights. We have to furnish lights during the daytime to cellars and dark offices, &c. Now we are going to have large batteries as I mentioned in the paper. We have large batteries there in our stations. Those will be charged during the night time, and they will be switched on to the main line during the day time. Therefore we won't have an extra relay of engineers and firemen, and in case of a break-down we will switch those on at once. We keep getting extra engines, and before the engine comes almost we have it all "filled up" with orders and have to get another one. We supposed we had 100 per cent. more power than we needed a year ago, and we haven't now enough.

Mr. F. L. POPE: I would like to ask Mr. Roberts if he knows of any other similar storage plant and incandescent outfit running anywhere in the country.

Mr. ROBERTS: No, sir; we are the only ones so far as I know.

Mr. F. L. POPE: The impression had prevailed that the system had been an entire failure, and it certainly was quite a surprise to me and to a great many others, I have no doubt, to hear of what Mr. Roberts had been doing, and of the great measure of success that attended him. It is evident that he has got through the worst part of it, and will have plainer sailing from this on.

Mr. ROBERTS: The plan of using in the station is what I believe to be the best use of the storage battery. I believe we shall make a good thing out of it. We don't look upon the storage battery as a failure, but we do not believe in it where we can get a number of customers close together and where we can get a station near them.

Mr. MARTIN: There is one point I want to inquire about—"batteries will be used in places distant from the station." From that I gather that the lights fed from those batteries are used in *private houses*.

Mr. ROBERTS: Yes, very largely. We have two private residence circuits. We have lights in every conceivable place there, almost. We have them in houses of all kinds of repute. We have them in gambling houses, churches, private residences, business places and every possible place you can imagine. We have them in the telegraph office and in the dispatcher's office of the U. P. road, and for all those places we have to have special arrangements.

Mr. MARTIN: In that case are you prepared to give your support to this statement which I find in the London ELECTRICAL REVIEW, which I received yesterday:—"Two years ago, or even less, we should have been very guarded in anything we had to say in eulogium of secondary batteries, but such very decided improvements have been made in these apparatus that for such purposes as that to which we have referred before, they may, under periodical and intelligent inspection, even now be safely recommended, and it is not too much to assume that as they are better understood so will further improvements follow." If you, after your experience, can indorse that, I think it would be saying a good deal for the secondary battery. I should like to know if you can say anything in regard to secondary batteries on the railroads of the country.

Mr. ROBERTS: As to railroads, I can say nothing more than what Mr. Potter told me the other day. I think it was on the Pennsylvania railroad. The results thus far obtained were very promising. With respect to the extract from the paper which Mr. Martin has read, I do not see any exception to be taken to it, provided they are willing to pay for what they get. In such cases, where they have water power it would probably be cheaper to have a dynamo and a storage battery than gas. In other places it might be cheaper for them to put in the gas. The main fact that they would, under periodical inspection, give a good light and be fairly economical, would, I think, be correct.

Prof. ANTHONY: I have never been able to find out yet what a storage battery costs—the first cost of one—and if that can be told I should like very much to know. Of course, if it is a secret, I do not wish to press the question.

Mr. ROBERTS: All I have on that is the private circular of the Brush Company. It is a private circular, and I have to refer you to the Brush Company.

Mr. F. L. POPE: From all that has been said it seems quite clear that the field that has been occupied by the storage battery is in the way of supplanting the direct system of incandescent lighting. This direct system is only practicable now for very short distances from the central station. When you go very far away the interest on the cost and maintenance of your conductors mounts up so rapidly that the cost becomes prohibitory. Now the storage system is evidently going to enable economically to extend the incandescent lighting system to a much greater distance from the central station.

Mr. ROBERTS: I think by next fall we shall be lighting a group of residences—new residences about two miles from our station; but it will depend somewhat on how we come out with another bit in the same direction. If the Government takes hold, the officers will probably light their residences also.

Col. HAZARD: I should like to ask, sir, whether the question of generating by wind power only has been the subject of any experiments—that is, driving the dynamos by the wind only, and then storing in the secondaries.

Mr. ROBERTS: Respecting wind only, one or two gentlemen in Cheyenne who have ranches far from town have spoken to me about it, but I have been too busy to go out and give them any figures.

Prof. ANTHONY: There may be cases where wind power would be valuable for such purposes for an isolated plant. But it seems to me that in most places there would be days or even a week together where the mill would not run with sufficient velocity to generate current enough to charge the battery. Unless you had the wind to do that, you would be without a charge for days together. It seems to me it would be an exceedingly unreliable power. My own feeling in regard to it is that steam power is the power for electric lighting; that even water power is not a power that is to be considered in comparison with steam, except under very favourable conditions. There are, of course, cases where the conditions are so favourable, where you can use it and rely upon it continuously from one year's end to another; but in a great many cases the water power fails at just the time you want the light. At Ithaca, where we are doing something in the way of electric lighting and have waterfalls enough, if the fall were all that was necessary, we could generate any amount of power. We have between our university and the lake about 400 feet of waterfall; but the trouble is that in some seasons of the year there is not much water. If we could be sure of water, I think we might use water power with perfect success; but occasionally the water fails, and then again there is more or less trouble from the running of *débris* in the stream that clogs up the wheels. My feeling has been that if we want a continuous and reliable electric light, something that will not fail us on occasions—if we want a light that people can always have at command when they want it like gas light, there is nothing like the steam engine.

Mr. THOMPSON: We had a secondary battery which we connected up over night with a steam engine accidentally. In the morning we found the steam engine running without any steam. Similarly, when a wind mill stopped for want of wind, the secondary battery would operate the dynamo as a motor, which in turn would propel the wind mill, unless, of course, an invention were provided for automatically cutting out the dynamo when the wind failed.

Prof. ANTHONY: I have been very much interested in this discussion and in the original paper, and I have been watching this storage battery question ever since the storage battery began. It seems to me that the storage battery is as necessary for the solution of the problem of electric lighting as the gas holder is for gas lighting. I think that the thing we want is coming some time. But there are a great many questions involved, and one of these is the original cost of the battery; that is what prompted the question I asked. I have heard the statement made that a storage battery that will do the same work costs three or four times as much as a dynamo, and a great many people have said, who profess to know something about it, that the first cost of the battery, the interest on the cost, and the depreciation, were so great as to almost prohibit the use of it: and I am very glad to know that Mr. Roberts has found the thing such a success that they are increasing the plant. That is evidence to me that they have found it valuable at any rate, and I do not see how it is possible for us to extend over any large area this system of electric lighting except by some such means. Certainly we can light small areas directly from the machines, but when you have to go any distance you must have the storage capacity; and until you have a battery you can use, you have not reached the solution of the problem of electric lighting.

THE ELECTRIC LIGHT IN THE LEEDS MUNICIPAL BUILDINGS.

WE are informed that the litigation in this matter between the contractors and the Leeds Corporation is at an end. The settlement arranged by the Town Clerk of the dispute between Messrs. Paterson and Cooper, electric engineers, and the Corporation, says the *Leeds Mercury*, satisfactorily closes the book on a story which it is to be regretted reflects no credit upon either of the litigants. "Messrs. Paterson and Cooper do not deny that the dynamos they supplied were insufficient, and that the lamps were imperfect and defective. So conscious were they of this that they offered from the first to supply new dynamos and new lamps, and to abide, in the terms of the contract, by the decision of an arbitrator as to the remaining matters in dispute. Unfortunately, the Committee which represents the Corporation in this matter of electric lighting has only, so far, been successful in spending public money. We are not the apologists of Messrs. Paterson and Cooper. We are as little disposed to be the apologists of the Committee, which, after years of inquiry and the expenditure of thousands, succeeded in involving the Corporation in a miserable squabble. We need not say that such a result ought not to have been possible It would be interesting to know how the money voted has been spent, and how it was that the Committee's labours culminated in so egregious a blunder; but in all probability the ratepayers will have to be content with the settlement now arranged by Mr. Morrison."

From another source we learn that the action was brought by the plaintiffs against the Corporation to recover an alleged balance due to them of £760 10s., consisting of a sum of £500, being the balance due under their contract for lighting by electricity

the Free Public Library; and £260 10s., extras in connection with the contract. Notice of trial had been given by plaintiffs for the present York Assizes. The Town Clerk reported that he had on Tuesday settled the action under the following terms of settlement:—"Paterson and Cooper *v.* the Corporation of Leeds.—Terms of Settlement.—All further proceedings in the action to be stayed, charges of fraud made by the Corporation to be unreservedly withdrawn. The dynamos at present at Municipal Buildings to be removed, and two new and efficient dynamos of Messrs. Paterson and Cooper's manufacture to be substituted therefor, each dynamo to be capable of giving an output of 9,000 Watts, and running with the present gas engines, 142 20-candle-power, Swan or other approved lamps, of 96 to 100 volts, and the dynamos to be capable of giving an output of 12,500 Watts, and of running twelve hours continually without overheating, if adequate power be provided by the Corporation. The dynamos to be tested at Messrs. Paterson and Cooper's works by, and to be satisfactory to Sir Frederick Bramwell, President of the Institute of Civil Engineers, on behalf of the Corporation. The plaintiffs to pay Sir Frederick's fee, not exceeding 25 guineas, the Corporation to pay any excess beyond that sum. Messrs. Paterson and Cooper to provide and fix 284 Swan or other approved 20 candle-power 96 to 100 volt lamps at their own expense. There to be no obligation upon plaintiffs to leave 100 lamps in stock, and they be allowed to remove lamps at present fixed in buildings. Plaintiffs' claim for extras to be referred to a gentleman of standing in Leeds or neighbourhood, to be agreed upon. £500 to be paid by the Corporation to plaintiffs immediately dynamos are satisfactorily at work. This to be before 1st October, and the extras to be paid for as soon as amount of same determined. The plaintiffs to run and maintain the installation for a term not exceeding 14 days at their own expense. The above terms to be embodied in a Judge's order if necessary. The Town Clerk added that now the dispute was settled, Messrs. Paterson and Cooper's solicitors assured him—and he believed that the assurance would be thoroughly carried into effect—that the new dynamos and the installation would be such as would reflect great credit upon Messrs. Paterson and Cooper, and give entire satisfaction to the Corporation and to the public. The Chairman said that the result was most satisfactory. Had the action been fought out, it would have been a very costly one, as the Attorney-General, Mr. Lockwood, Q.C., and Mr. Moulton, Q.C., had been retained as counsel for the Corporation. The briefs, however, had not been delivered. Sir Richard Webster's retainer was given by the Town Clerk some months before he was Attorney-General; and the fact of his being made Attorney-General, and also the fact of Mr. Moulton being made a Queen's Counsel, would have seriously increased the cost of the trial at York; while the attendance of Sir Fredk. Bramwell, Dr. Hopkinson, and the Corporation's other scientific witnesses, would have entailed further expense. He should like to add that he believed Messrs. Paterson and Cooper would carry out the above-mentioned arrangement in such a way as would entitle them to say that the dynamos supplied to the Corporation had given satisfaction to everybody.

IMPORTANT TELEPHONE PATENT CASE.

(*Continued from page* 102.)

(*Specially reported for the* ELECTRICAL REVIEW.)

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

(*Before* MR. JUSTICE NORTH.)

UNITED TELEPHONE COMPANY, LIMITED, V. BASSANO AND SLATER.

Saturday, July 18th.

Mr. HOLLINS, continuing his evidence this morning, said in every case save one in Edison's specification there was direct mechanical connection between the diaphragm and the tension regulator; in the exception, fig. 12, the connection was by magnetic induction. The material of which Edison's diaphragm should be made must be of a non-resonant character. For this view he relied upon the words in page 5, line 12 of the specification: "After extensive experiments I find that mica is almost entirely free from any resonant action," and he therefore recommended mica.

Mr. JUSTICE NORTH: Do you consider that the diaphragm described by him must be mica?—He prefers mica.

You don't consider that the specification describes that it must be mica, but that he prefers mica?—That is so. I also think Edison's diaphragm should be a tympan—should be fastened round its circumference. It is so described, except in one instance, where it is fastened in the centre. The effect of speaking upon a tympan is to produce vibrating ripples with circular nodal lines. A common sounding board would not act as a tympan, unless secured round its edges; the waves of sound would merely produce a tremor. It should be something, too, not sensible to atmospheric action; mica is not sensible to atmospheric action, whilst wood is. The moisture from the breath would make a diaphragm of wood less ready to respond to the sound waves. I have frequently seen the wooden diaphragms in Gower-Bell instruments split under atmospheric influences.

Mr. JUSTICE NORTH: Supposing it was polished?—It would not have so much effect upon it; but it would soak in in time. The object of the black cone in the defendants' transmitter was to collect and transmit the sound waves to the pencils, and, by moving the carbon pencils in the carbon blocks, vary the resistance of the electric current at the point of contact. The object of the black base is simply to hold the carbon blocks, and the red back is for the transmitter to stand on; the reason it stands out so far is to prevent the speaker from striking his head against the wall. Neither of these was a diaphragm, or served the purpose of a diaphragm. The instrument would act if a hole were hollowed out of the red back, and some had been manufactured in that way; the speech was more distinct. I was present at the experiments spoken of by Professor Forbes. When the hard carbon pencil was in circuit, the defendants' transmitter transmitted speech perfectly, but when the gum rubber and fibre was in circuit no sound was produced; when tapped with the hand, a very faint tick was heard.

Mr. JUSTICE NORTH: Is not that to be accounted for by the difference in the looseness of the two?—I don't think so; I have tried them in all possible positions.

One is much longer than the other; supposing the gum rubber stuck in its place, would you hear anything?—No, my lord, it must be loose.

And if a sharp tap was given to it to separate it, might not a tick be heard?—Yes. But it is a mere accident if there is any difference between the two. I confirm Professor Forbes's statements as to the experiments made by him. I tried another experiment, using an ordinary speaking tube; attaching to it two carbon pencils and a split carbon ring at the further end; one end of the tube was supported on a brass arm projecting from the wall; this was simply perfect as a transmitter. The black base in the defendants' transmitter is made of wood, of what kind I do not know; the red back is mahogany.

Mr. PLUMPTRE: What do you understand that Edison's tension regulator should be made of?—There are several different forms. I have made most of them with the object of trying them, but have not succeeded in making one of them speak. Edison says his tension regulator must be a semi-conductor. Where good conductors are used they are mixed with the very best insulators to make them semi-conductors. In the case of lamp-black in the tube, air would be the insulator. Hard carbon is a good conductor. I am not prepared to say that in all cases there should be compressibility; there is pressure of course.

What distinction do you draw between the two?—I take fig. 1 to mean that there is compression through the mass. In fig. 10 I should scarcely take it to mean that. There is pressure there at the point of contact, and pressure would enlarge the surface contact.

Now, as regards the defendants' tension regulator, what do you find there?—I find there hard carbon, known as candle carbon in arc lighting. A yard of it has scarcely an ohm of electrical resistance. Looking at it in operation through a powerful microscope, there seems to be an enormous number of fine points constantly changing. I do not mean that there is actual make and break; there are always some contacts.

Would it be a right way of describing that action as varying the resistance by looseness of contact?—That is so. It is what you may term a fault in the circuit. The action is the same as in the microphone.

Mr. JUSTICE NORTH: Is a microphone always in a closed circuit?—I believe so, but there is a difference of opinion.

Cross-examined by Mr. MOULTON: When you speak of any solid body capable of taking up the waves of sound, is it not a fact that in addition to waves of sound it takes up from your voice vibrations of its own?—Certainly; generally.

And will it not repeat to a tension regulator that note of its own as well as the notes of the voice?—Yes, I should say it would.

And that would interfere with the sound at the end?—I don't think it would be so distinct.

And, therefore, it is an advantage not to have this resonance of its own in the diaphragm?—If you can get rid of it.

And that is true whatever be the construction of the transmitting instrument?—I should say so.

Do I understand you to say that there are not nodal lines unless a diaphragm is supported round its circumference?—Certainly not; there is nodal vibration in a string. The nodal lines are not circular unless the diaphragm is fastened round its edges.

They are modified, in fact, by either variation in thickness or quality in the plate, or the mode of support, or anything that influences the vibration?—Yes, I think so.

With regard to the tension regulator: taking two pieces of carbon and resting one upon the other, does not the resistance at the point of contact diminish immensely when you press them?—When they are once in contact, yes.

And a very slight increase of the pressure makes a considerable difference?—I do not think it is considerable.

You say that in Edison's specification the tension regulator is in mechanical connection with the diaphragm, do you not?—With the platinum foil attached to it; that is to say, in most cases.

Do you suggest that in defendants' it is not in mechanical connection?—With what?

With the black base?—The carbon blocks are attached to the black base.

These carbon blocks are supported on a piece of thin black board, which is fastened to the back; is it not so? Do you suggest then that they are not in mechanical connection with the red back?—Taken altogether, certainly they are.

Do you suggest that the red back does not take up acoustic vibrations?—I dare say the red back does to some extent; but I believe that when the cone is attached to it, as in the defendants' instrument, the direct action of the sound waves has more to do with the transmission of speech than either the back or the black case.

Apart from what they get from the direct waves, the carbon blocks in the defendants' instrument get all the vibrations that those pencils get from the solid part of the instrument?—Well, I don't know.

Do they not get the same vibrations from the solid parts as the plaintiffs do?—I do not think so; because there is nothing to stop the sound waves going from the base. In the defendants' there is.

Do you mean to say that would make any substantial difference?—Yes, I do.

Did you hear that that instrument (defendants') spoke perfectly well when that hole was quite stopped up with a cork?—I do not doubt it.

In that case the vibrations came all from the solid parts of the instrument?—I suppose so.

With regard to the plumbago pencils, did you test what their resistance was?—I believe it was from 700 to 1,000 ohms.

What was the resistance of the carbon?—From 10 to 15.

And therefore, if you use the same battery power you are trying to make one work with $\frac{1}{70}$th the current of the other?—Yes.

Do you call that fair?—Yes, I do; for carbon you never use more than two or three cells; the more you increase it the less is the variable resistance at your disposal.

Do you suggest that if you honestly wanted to make this work you would take the same battery power for a thing with 70 times the resistance of the other?—I cannot see that there is anything in that at all.

You choose your battery power to suit your resistance, do you not?—In telegraphic circuits; not in telephonic circuits. I never knew a telephone used with more than two or three cells.

Do you, as a telegraphist, suppose that you would get the same result with the same battery power?—Not in a telegraphic circuit, but I should expect it in a telephone.

Mr. GEORGE HENRY BASSANO, one of the defendants, a telegraph instrument maker, of Derby, was next called. He said he found in the plaintiffs' transmitter a diaphragm of mica; there was no diaphragm as described by Edison in the defendants' transmitter. He did not consider either the black cone, the black base, or the red back to be diaphragms. The object of the black cone was to concentrate the air-waves from the voice upon the tension regulator at the bottom of the tube; the function of the black base was to hold the carbon blocks which supported the carbon pencils; the red base was intended as a support to the whole arrangement. He had been present at most of the experiments that had taken place, and concurred in what had been given as the result by the other witnesses. Edison only recommended one kind of material for a diaphragm, and that was mica, and he gave his reason for so recommending that. It was important not to have a diaphragm of a resonant character, because a substance of that character vibrated at its own pitch, giving a secondary vibration which would interfere with the clearness and distinctness of articulation. Edison did not, so far as he could recollect, mention wood as a material of which to make a diaphragm. One of the characteristics of the Edison tension regulator was that it should be of a semi-conductive character, that object being attained by mixing a good conductor with what was practically an insulator. All the materials named in the specification were semi-conductors. He should call hard carbon a good conductor. Hard carbon, he should say, must be to some extent compressible by virtue of its elasticity, but not in the sense that Edison contemplated. Defendants' tension regulator was formed of hard carbon, and it acted microphonically, so far as he could understand; he was not prepared to say positively how it did act.

Cross-examined by Mr. ASTON: Speaking in the neighbourhood of the tube in your transmitter, either at its side or down it, would not the sound waves be taken up by both the tube, the circular base, and the red back?—To some extent they would.

More particularly, probably, by the circular base and the red back?—Yes, I have no doubt it would be so.

The carbon blocks are fixed directly into the circular base, which rests on the red back?—Yes, they are in direct connection—wood connection.

Then would the vibration given to the black base and the red back be communicated to the carbon blocks?—Certainly they would, whatever vibrations there were.

And the blocks and the pencils would have motion imparted to them relative to one another?—To the extent that the case vibrated.

And the result would be pressure upon the carbon surfaces in contact?—I would rather say change of position.

Do you mean that you could have change of position between the blocks and the pencils resting upon them without, speaking strictly, there being some pressure?—There would be some pressure.

Would not the pressure vary the extent of the surface in contact?—It would, to the extent of the compressibility of the carbon.

Would not that vary the resistance of the electric current?—Yes, it would.

Synchronously with the vibrations set up by the sound waves?—Yes.

Your transmitter is connected with a closed circuit?—Yes.

And would not the result be that the sound waves created by the voice at the transmitter end would be reproduced at the receiving end, where the listener is situated?—That is so.

You were asked whether carbon was not a good conductor, and you said it was?—Yes.

Did you hear Mr. Conrad Cooke say that, having regard to the introduction of carbon as a tension regulator into a closed circuit, it might, as compared with the circuit in which it is placed, be fairly called a semi-conductor?—In that sense, compared with the circuit, it would be a bad conductor.

In Edison's specification he proposes to use forms of carbon as tension regulators?—Yes.

And under this condition it would not be fair to call those forms of carbon semi-conductors?—It would not.

Is not the second form of carbon described by Edison one in which he has two surfaces in contact, covered with a coating of plumbago?—Yes.

In that case the plumbago would act as a tension regulator, would it not?—Yes, it would.

And in that case would you not have carbon acting as a semi-conductor in a circuit as proposed by Edison?—In that case you would.

This was the defendants' case, and the Court adjourned till Monday.

Monday, July 20th.

This morning Mr. PLUMPTRE addressed the court for the defence. He said he thought it was common ground that the question was as to whether there was a diaphragm in the defendants' transmitter which would come within the patent of Edison. If he was in a position to show, and he thought he was, that they had not a diaphragm, or a tension regulator, then his lordship would be justified in giving judgment for the defendants. What was the principle upon which the tension regulator in the plaintiffs' transmitter acted? He thought he was justified in saying that in every case, there was some use of a diaphragm to compress an elastic, semi-conducting body in contact with it, or to exercise a varying pressure on a nicely adjusted surface of a semi-conducting body placed near it. Adjustment was everything in the Edison tension regulator. There must be that close and fine adjustment of a diaphragm and tension regulator, so that the play of the diaphragm might be able to have exactly its proper effect upon its tension regulator. To put it shortly, it was that compressibility of, in nearly all cases, some fibrous, semi-conducting material; it was that compression, or pressing down caused absolutely by the diaphragm in its adjusted position, acting upon a tension regulator which caused that variability of resistance in the line which was required for the transmission of speech. The tension regulator of the defendants was a microphone, and in point of fact, he doubted very much whether to name it a tension regulator at all was not a mistake. There was no regulation. You had no means of knowing how you regulated the electric resistance; all you knew was that you had. But used in the same sense as used in the Edison transmitter, there was no regulation by adjustment whatever. Professor Hughes's experiment showed what he meant. Taking a bundle of nails, and putting them one on another, and passing through them an electric current, speech was transmitted without any other external assistance whatever. It might be placed upon putty, it might be placed in the air, and yet, wondrous as it was, and to some extent inexplicable, you had the effect of varying the resistance of the line by speaking to it. No diaphragm was required; no regulation was required, and no adjustment. What caused the result nobody exactly knew; at least, nobody could exactly define. It was a difficult question to decide where the one method of operation terminated and the other commenced, but, he submitted that, although perhaps it was impossible for him to define where the method of varying the resistance by compression shaded away into a totally different mode of doing it, namely, by the microphonic principle or method, yet there was unquestionably a difference.

Mr. JUSTICE NORTH: Is not the Theiler instrument something like the heap of nails in principle?

Mr. PLUMPTRE: There you get the contact and the adjustment of the diaphragm acting upon the blocks and pencils.

Mr. JUSTICE NORTH: I am quite aware that there is the element of the diaphragm, but I do not quite follow you as to the adjustment.

Mr. PLUMPTRE: You will find that the diaphragm is in mechanical connection with the so-called tension regulator. Adjustment is everything in that instrument.

Mr. JUSTICE NORTH: What do you mean by adjustment?

Mr. ASTON: There is the gravity of the "knocker;" that is all, my lord.

Mr. JUSTICE NORTH: What I am speaking of is the way in which one of these pencils rests upon the other two, like one of the nails in Prof. Hughes's experiment rests upon the others.

Mr. PLUMPTRE: Yes, my lord. But then you are excluding a very important element, the fact that there is direct contact made between the diaphragm and the carbon blocks. There you have, in point of fact, what is practically the action of the microphone, plus a diaphragm.

Mr. JUSTICE NORTH: Leaving the diaphragm out of the case for a moment, I want to see if there is any difference between the operation of these three pencils and the nails.

Mr. PLUMPTRE: No, my lord, I don't think there is. I should say if you take away the diaphragm you have the microphonic action.

Mr. JUSTICE NORTH: You must recollect that I put questions merely for information. It is difficult for a person with no experience in it to follow it, and very hard to be sure of appreciating the points which come up.

Mr. PLUMPTRE, continuing, said directly the diaphragm was taken away there was the action of the microphone. If his Lordship was of opinion that there was really no distinction between the microphonic principle and the principle of a tension regulator, it was almost impossible to say how much, he would shut the door against anything like the applicability of scientific knowledge.

Mr. JUSTICE NORTH: I do not quite follow you there.

Mr. PLUMPTRE: What I mean to say is this, if these two are the same in principle, it is almost impossible to see how there can be devised any form of tension regulator that may be used in future experiments.

Mr. JUSTICE NORTH: I do not see the difficulty there. There may be such discovery, but if not and somebody has already occupied the ground, he has the advantage of it.

Mr. PLUMPTRE: What I mean to say is, there you get an entirely new field, when you get that capacity of varying the line, not by compression, but by looseness of contact. If looseness of contact is held to be within the compression principle you give it an extraordinarily wide embrace, and I cannot conceive how any tension regulator could be used, unless it came within that embrace. As regards the characteristics of Edison's tension regulator, Lord Justice Fry, and indeed all the witnesses have agreed that first of all there must be compressibility.

Mr. JUSTICE NORTH: So far as that goes your pencils are compressible.

Mr. PLUMPTRE said the difficulty in arguing a case of this kind, and he supposed the difficulty of forming a judgment or giving an opinion upon it, was that throughout in nearly everything there entered the question of degree. He believed there was nothing known in nature as an absolute solid, without particles of air intervening between the various molecules. If there was no such thing as an absolute solid, it followed that when there was pressure of contact, however minute, there must be compression. If he placed a feather against a wall there was compression; but was that compression in the sense meant by Edison? It had been pretty well admitted that hard carbon was not compressible in any appreciable degree. If Edison, who wanted a compressible material, intended to use, or looked upon, hard carbon as compressible, why did he not mention it? It was true there were some forms of carbons; but there was no mention of hard carbon, whilst he presumed if the expression, hard carbon, had been used it would have included everything. Instead of that, he took various forms of carbon, and in every case mixed them either with air or with some soluble material. It was hardly worth his while to deal with resiliency, because there again it was a question of degree. Lastly, there was the element required of the conductivity of the material used. In every case the material mentioned by Edison was semi-conducting, and he thought he was right in saying that in most cases that semi-conductivity was procured by the combination of a good conductor with a bad.

Mr. JUSTICE NORTH: Speaking of the first portion of the tension regulator he says this: "bunches of semi-conducting elastic fibre, such as particles of silk, and an intermediate conducting or semi-conducting material." What does he mean by semi-conducting material there?

Mr. PLUMPTRE: By that, my lord, I think he means a powdered conductor. You may take a good conductor and directly you powder it you get the intervening air molecules which make it a semi-conductor.

Mr. JUSTICE NORTH: He uses the phrase there in two different senses. He uses "semi-conducting elastic fibre"—by that I understand him to mean the whole thing—"such as particles of silk and an intermediate conducting or semi-conducting material." Does that mean the same thing?

Mr. PLUMPTRE: I should think so. I think it is quite clear that he means the same thing, that if you take a bad conductor like silk you must make it a semi-conductor by rubbing it with something that is a good conductor.

Mr. JUSTICE NORTH: That is what I do not quite see. First of all he says, "small bunches of elastic fibre." That is what you want to get. Then he describes something else, "such as particles of silk, and an intermediate conducting or semi-conducting material." So that there is something he describes as semi-conducting material which is one of the two constituents which together make up the semi-conducting whole.

Mr. PLUMPTRE: Does it not amount to this, that if you take a non-conductor you convert it into a semi-conductor by using with it a semi-conductive material?

Mr. JUSTICE NORTH: I can understand making it a semi-conductor by taking a good conductor and a non-conductor. Does this not indicate that the result is to be got by mixing together a non-conductor, not with a good conductor, but with a semi-conductor? And what does semi-conductor mean in that connection as a constituent as distinguished from the whole being a semi-conductor?

Mr. PLUMPTRE: If he means that, he gets something which is not quite so high on the whole as a semi-conductor.

Mr. JUSTICE NORTH: I do not think semi-conducting means any exact degree, more or less, You may have several semi-conductors, each having more or less conductivity than the others.

Mr. PLUMPTRE: If he uses a non-conductor and mixes it with a good conductor, he gets a semi-conductor; if he uses a non-conductor and only rubs it with a semi-conductor, he gets something which may be called lower than a semi-conductor; and if he means that, so far better, according to my argument, for me. But now comes the question, what is a semi-conductor? Hard carbon, I think it has been admitted, is a good conductor, if you compare it with the whole scale of things. It is contended that Mr. Edison did not mean, when he used the word semi-conductor, to compare it with the whole scale of conducting materials, good, bad, or indifferent, but that he limited his comparison to carbon on the one side, and metals, the best conductors, on the other hand. Now, I cannot see, with the utmost respect to my learned friends, the ground for limiting the comparison in that way. Here, when Edison says he means a semi-conductor, why should he not be taken to mean a semi-conductor as compared with all things? At the top of the tree we have the metals; then at a gap as compard with metals, perhaps somewhat large, but only mentioned in hundreds, carbon; then, at an enormous gap below that, a million times, you have, I think it is, paper saturated with sulphuric acid; below that, again, millions of times lower down, you have things like fibres, glass, and so on; and taking the whole scale it is only fair to place carbon under the category of the good conductors with the metals. Passing to the diaphragm, what is meant by the expression diaphragm? With great respect to the scientific evidence, it does seem something quite startling to hear of the extraordinary constructions that have been put upon that word, more especially when it is considered that the word diaphragm is used interchangeably by Edison with the word tympan. Lord Justice Fry said that a diaphragm must vibrate, and on that, as it seems to me, the plaintiffs have said that because a diaphragm must vibrate everything that vibrates is a diaphragm. It has been likened to paper held up, never mind of what shape; it has been likened to the wall of this court; it has been likened to the circumference of the body; and lastly, Mr. Imray says, and I quite agree with him, that taking that meaning of the word diaphragm there is scarcely anything which may not be so called. It is impossible to say that Edison, when he used the words diaphragm and tympan interchangeably, ever meant the very broad construction placed upon them which we have heard. It is said that the black cone and the black base in our instrument are diaphragms. If we pause for one moment to examine this portion of the instrument (the black base) by itself, I do respectfully ask your lordship whether, in the ordinary meaning of the term, if that was held up to you before you heard this cloud of scientific definitions, and you were asked, "Is there a diaphragm here?" your lordship would say there was. A diaphragm, we have heard, is "something through," a "separator," and used in every science as something separating one cavity from another. Bearing in mind one's preconceived idea of what a diaphragm was, I cannot imagine how any person seeing this portion of the instrument could possibly say, "Here is a diaphragm." Then there is a further diaphragm, so called—the red back. Taking the plaintiffs' transmitter, I have here three parts exactly coinciding with those in the defendants' instrument. I asked Mr. Imray if he considered the black base, the black cone, and the red back, diaphragms, could it not be said in the same sense that the yellow cone, the yellow back, and the yellow base in the model of the plaintiffs' transmitter were diaphragms? He said, "Yes." Now, my lord, "I searched the specification to find whether I could there see anything which would lead me to suppose that Edison looked upon these as diaphragms. I could find no such description of them. But, my lord, I do find that they are called something; I find that this mouth-piece is called "a resonant tube or box," and that this base, although not named *per se*, the whole of it is called "the handle." If Edison looked upon these as diaphragms, why did he not call them diaphragms? Why did he give them different names altogether? And I find—which I think is of some importance for your lordship's consideration—that among the original claims that handle is claimed. To put it shortly, I am entitled to say that although he has given specific names to these parts, nowhere does he claim them as a diaphragm. I asked Sir Wm. Thomson and Mr. Imray, when I had got them as far as this, that these three things might be considered diaphragms in the same sense as in the defendants' instrument. I asked them whether they had any doubt whether, when Edison used the word diaphragm, he did not mean that brass plate, and both Sir Wm. Thomson and Mr. Imray said "Yes." What Edison meant by the diaphragm was this brass plate, and nothing else. I would call your lordship's attention to the fact that he claimed a diaphragm and not diaphragms. Then, if Mr. Edison meant these three parts, inasmuch as these parts are made of wood, one would expect to find in the materials which he uses as diaphragms wood included.

Mr. JUSTICE NORTH: That exhibit which you have in your hand is of your making, is it not, Mr. Plumptre? What is the aim of putting in a brass diaphragm? There is no special reason?

Mr. PLUMPTRE: None whatever. Continuing, he said: But I do find, my lord, that the material that is described by Edison as being the material which he describes should be used is mica, and your lordship will find that in what I call the true diaphragm, mica is used. Is it not therefore clear, upon another ground, that when Edison used the word diaphragm, he meant a diaphragm made of mica? I do not mean that Edison claims the

exclusive use of mica; all I would say is that, having described the diaphragm as mica and having used his diaphragm as mica, that is evidence to show which of the four so-called diaphragms is the one he meant when he uses the word diaphragm. The same remark applies as to what Edison regards as the desirability of having something which is not capable of being influenced by atmospheric action. We find that for his true diaphragm, which we have not got, he has chosen something undoubtedly not influenced by atmospheric action; the so-called diaphragms, which, I say, are not meant for diaphragms, but which are analagous to the parts in ours which are termed diaphragms by the plaintiffs, are made of wood, which is capable of being influenced by atmospheric action, although I do not mean to say that to some extent that action is not lessened by polish.

Mr. JUSTICE NORTH: I do not wish to intimate any opinion about it; but do you say, supposing there had been a plate of wood at the place corresponding with what you say is Edison's diaphragm, that plate of wood would not have been a diaphragm? And if, instead of being put there it is put behind the tension regulator, does that make any difference?

Mr. PLUMPTRE: No, my lord. I am putting a proposition now on the ground that the whole of the witnesses have said that when Edison used the word diaphragm he did not mean any of the so-called wooden diaphragms. In Edison's transmitter, the diaphragm is an absolutely essential element. I think the Attorney-General said, in his opening, that if you take away any of our so-called three diaphragms our instrument will not act. I think the experiments brought before your lordship's notice were made to show that it does act. If it was a fact that our tension regulator would not act without the diaphragms, so-called, although I do not for a moment say that would be by any means conclusive, it would undoubtedly be a very strong argument in favour of the plaintiffs. But there have been some extraordinary experiments tried to see whether or not our tension regulator would act, not only without a red back but without any assistance in any sense whatever except the voice and the electric current. Your lordship has heard the experiment, where the instrument was held up without the red back, and though perhaps it was not quite so loud, it was more distinct; there was not that kind of jar or vibration which occurs when you have the red back. The experiment was then tried of a tension regulator, and the two carbon blocks being put on a putty stand, which in its turn rested upon the floor. I do not really know how it is possible to cut off all elements of a resonant nature more effectively than by making that experiment. What was the result of that? Prof. Forbes, Mr. Conrad Cooke and Mr. Hollins all saw it, and they all say that they were startled by the manner in which it answered. We heard it, too, and I think your lordship said that of all the experiments tried, the putty was best. Sir William Thomson gave your lordship an account of some tests which, at the first blush, looked the other way, and which, as they stood, were, of course, of great importance. He went further in the experiment; he took out the tension regulator and supported it in space, about as crucial a test as you can get; he said he could not get it to speak. Now, with the utmost respect, I say that is not a fair test, and for this reason, that our carbon blocks must be fixed, and in Sir William Thomson's experiment the carbon blocks were suspended, the whole thing vibrating, as a matter of course. We improved upon that experiment, but we did what was fair, and we had it suspended first of all upon two sticks; but we cut off all element of vibration by putting corn plaisters between the sticks and the blocks. This spoke; but not satisfied with that experiment, we went still further, and Mr. Conrad Cooke performed the experiment of having the tension regulator suspended by tapes—tape is preferable to string, because there is less vibration—and, of course, in that case all vibration was brought down to zero. I do not see how it is possible to put that tension regulator in a position where it is less liable to anything like vibration. So then we had in that experiment nothing but the voice acting upon it—no diaphragm, no resonant tube, no back, nothing whatever; the instrument spoke. So, my lord, I cannot help thinking, with great respect, that those experiments show that so far as those three parts, the black cone, black base and red back, are concerned, not only are they not required, but, in point of fact, they are rather detrimental to the working of the machine than otherwise; certainly the red back is so. What we put those parts there for is this. Something is wanted, naturally, to focus the air waves, as there is in almost every instrument that is used for the transmission of speech; and then we want a support, and we use that portion (the red back) as a support. For that purpose these parts may be used; but I think I have shown that in no sense are they necessary for the working of our machine and for making the tension regulator perform its functions.

(To be continued.)

TELEGRAPH ACTS AMENDMENT BILL.

ON the motion for going into committee on the Telegraph Acts Amendment Bill on Thursday, the 30th ult.,

Mr. ALDERMAN LAWRENCE said that he was in favour of the principle of free addresses, as in the case of the present shilling telegram. He observed from the amendment of the Postmaster-General, to be moved in committee, that the right hon. gentleman was in favour of a free address and three words for 6d., and he hoped that he would consent to increase the number from three to four, with a halfpenny a word afterwards.

Mr. HUBBARD observed that the hon. member who had just spoken stipulated for a fixed price—for what? For a variable quantity, which was contrary to political economy. The proposal of the late Postmaster-General was exceedingly reasonable and distinct in operation.

The House then went into committee on the Bill.

Lord J. MANNERS said that next to securing the passage of the Bill, his object was to secure the retention of free addresses for all telegrams sent after it became law. In making his proposal he was bound by the same restrictions as those laid down by the Treasury, and which limited the loss to the department on the scheme at £180,000 per annum. He would at once ask the committee in deciding upon the scheme not to consider the interest of any section or sections of the community, but of the whole telegraphing public. That, at least, was his object, and he maintained that if the scheme of his predecessor, which made no provision for free addresses, were carried, the object would not be attained. The public themselves were after all the best judges with regard to the question of free addresses, and from all the evidence he had been able to collect, and all the communications were entirely in favour of the establishment of free addresses. In his opinion the State had not paid millions of money to private companies for the telegraph in order that highly respectable and influential classes, such as merchants, stockbrokers, and traders should be benefitted, but that the whole community should profit by the change. The scheme of the right hon. gentleman opposite (Mr. Shaw-Lefevre) depended on the arbitrary assumption that the public using the telegraph could conveniently cut down the words in their addresses. That was a pure assumption, and had not to his mind much foundation in fact. The great body of the telegraphing public would have to decide for themselves how many words it was necessary to expend on their addresses, and to what extent they could safely and satisfactorily curtail them. The late Mr. Fawcett had said that the abolition of free addresses would press severely on the poor man, who it was obvious would require a further address than a rich or well-known man. Very often in telegrams sent by or to soldiers, for instance, there were as many as 16 words, and in such cases, he asked, would not much mischief, delay, and vexation arise through the abolition of free addresses? It was true, as the officers of the department had pointed out to him, that much expense was entailed by those long addresses, but from his point of view it was the convenience of the general public that had to be borne in mind. He had been informed that addresses were charged for in foreign countries, but in that respect he ventured to think that we were ahead of them. He was bound to confess that in his opinion the right hon. gentleman who framed the Bill was asking Parliament to assent to a retrograde movement. The abolition of free addresses would very considerably affect a great number of people in Scotland, Wales, and Ireland who lived in districts where the same surnames abounded, for it was clear that unless there was a distinct address to distinguish one Jones, Daley, or Macdonald from another great confusion could not fail to arise. Something also had to be said for the metropolis, where there were a great many streets bearing the same designation. He had had a list prepared of streets of the same name in London, where there were no fewer than 54 Albert Villas, 61 Albert Terraces, 38 Avenue Roads, 60 Cambridge Terraces, 75 Charles Streets, 59 Church Streets, 52 Elizabeth Places, 64 John Streets, and 70 Park Villas. The committee should therefore hesitate before they abolished free addresses, under which the telegraph system had expanded in a very satisfactory manner, and of which no complaint whatever had been made. If free addresses were once abolished they would never be reinstated, but, on the other hand, if the committee were pleased to adopt his alternative scheme there was nothing whatever to prevent its further extension when the financial affairs of the Department permitted it. Holding as he did strong views upon the subject, he asked the committee to vote for the maintenance of free addresses.

Mr. SHAW-LEFEVRE said that he had no complaint whatever to make of the course pursued by the noble lord with respect to his treatment of the Bill and himself (Mr. Shaw-Lefevre). He hardly expected that the noble lord would accept the Bill *in toto*, and he must, therefore, confess that he had acted very satisfactorily in leaving the committee to decide between the two propositions. The two alternative plans were identical as far as financial considerations were concerned, but he ventured to say that the noble lord had not quoted one single authority in favour of his proposal. He should like to know whether any of those ladies and gentlemen and soldiers to whom the noble lord had referred had ever had his scheme under their consideration, or could he find any one in the Department to whom it would prove satisfactory. He ventured to say that there was not a man in the Telegraph Department who would not condemn it as likely to lead to great dissatisfaction, both on the part of the department and of the public. The only question between him and the noble lord was what was to be given for 6d. According to his (Mr. Shaw-Lefevre's) calculation, which was confirmed by the telegraph officials, if his proposal were adopted five words would be required for the address and seven for the text of the message. In a very large number of cases the sender's name need not be sent at all. The committee could hardly be aware of the waste which took place in the matter of addresses. That waste occupied the staff unnecessarily, and caused much delay in the transmission of telegrams, as well as an enhanced cost, which the public had ultimately to meet. By way of example, he had obtained from the department

three specimens of this unnecessary expenditure of words. The first was in a telegram from a milliner at Dover, who used no fewer than 32 words to describe her address. The second was from a noble earl, who, having obtained some advantage on a Bill before Parliament, telegraphed to a justice of the peace in the county informing him of the fact, and using in the two addresses as many as 46 words; and the third was a message from the late Postmaster-General himself stating that the Telegraph Acts Amendment Bill would not come in, where he used 11 words for the address, when, as it was afterwards pointed out to him, only three were necessary. He had come to the conclusion that it was absolutely necessary in the interest of the senders themselves to put some limit upon this system, and the only way to do it was, he believed, by charging for the addresses. The waste of words on the estimated increase in the number of telegrams under the 6d. tariff would represent a loss of £250,000 a year, while three words, as proposed by the noble lord, being insufficient for a message, would, by extra payment, cause the public an expenditure of about £260,000, so that from a financial point of view the two schemes were thus far identical, but under the Bill the average cost of a message would be 7½d., and under the noble lord's scheme it would be 9d. He ventured to think, therefore, that the former proposal would be more advantageous to the public. In all cases where the addresses were under nine words the sender would be better off under his own tariff than under that proposed by the noble lord. If a telegram were sent for 9d. only nine words could be sent under the noble lord's scheme, whilst 13 could be sent under his own. If the message cost 1s., only 15 words could be sent in the one case, and 19 in the other. Therefore, on all these points his tariff compared favourably with that of the noble lord. Under these circumstances, he thought that from whatever point of view they regarded the question the committee would come to the conclusion that the tariff of the noble lord was unsatisfactory. There was another point to be considered. If only three words were conceded in the text, there was very great danger that the senders of telegrams would use the address for the purpose of a code. He was told that this was done already to a certain extent in Glasgow, and he knew that the permanent officials of the department had very great reason to fear that the practice would extend if such a proposal as that of the present Postmaster-General were adopted.

Mr. E. D. GRAY said the proposition of the noble lord would, if agreed to, leave the public in a much worse position than that of his predecessor in office. What the committee ought to obtain from the Government was a scheme embodying the number of words proposed by the late Postmaster-General with the improvement of free addresses suggested by the noble lord when he was untrammelled by the cares of office, and not subject to the heavy hand of the Treasury Department. He believed that if the Post Office were better managed the authorities would be able to give to the public a 12-words message with a free address without sustaining any loss. It was stated that the press messages sent during the year involved a loss of from £150,000 to £200,000 a year. If this was the case, he did not see why the Government should subsidise the press, or why they had not asked Parliament to revise the newspaper tariff. As to the present proposal, it was evidently prompted by a desire on the part of the noble lord to be consistent in and out of office, and appeared to him to be absolutely ludicrous.

The CHANCELLOR of the EXCHEQUER: I hope the hon. member who has just spoken will not vote under any mistaken idea. We could not consent to proceed with a Bill which would do what he wishes to be done. We could not agree to give free addresses and a larger number of words than are proposed by my noble friend. We could not agree to impose on the Treasury a larger burden than is intended to be imposed by the Bill. It is for the committee to decide whether they will accept the scheme of the right hon. gentleman opposite or that of my noble friend. Whichever they accept we will undertake to carry it out.

The committee then divided, with the following result:—

For Lord J. Manners's amendment	62
Against	108
Majority	46

The amendment was, therefore, negatived, the announcement of the numbers being received with cheers. The clause and the remaining sections having been agreed to without amendment, the House resumed.

SUBMARINE TELEGRAPH CABLES BILL.

THE following are the clauses of this Bill, as amended in Committee. It is intituled "An Act to carry into effect an International Convention for the Protection of Submarine Telegraph Cables."

I.—This Act may be cited as the Submarine Telegraph Act, 1885.

II.—The Convention of the 14th of March, 1884, mentioned in the schedule to this Act as set forth in that schedule is hereby confirmed, and subject to the provisions of this Act the articles of such Convention (referred to in this Act as the Convention) shall be of the same force as if they were enacted in the body of this Act.

III.—(1.) A person shall not unlawfully and wilfully, or by culpable negligence, break or injure any submarine cable to which the Convention for the time being applies, in such manner as might interrupt or obstruct in whole or in part telegraphic communication.

(2.) Any person who acts or attempts to act in contravention of this section shall be guity of a misdemeanour, and on conviction—(*a.*) if he acted wilfully, shall be liable to penal servitude for a term not exceeding five years, or to imprisonment, with or without hard labour, for a term not exceeding two years and to a fine either in lieu of or in addition to such penal servitude or imprisonment; and (*b.*) if he acted by culpable negligence, shall be liable to imprisonment for a term not exceeding three months, without hard labour, and to a fine not exceeding £100 either in lieu of or in addition to such imprisonment.

(3.) Where a person does any act with the object of preserving the life or limb of himself or of any other person, or of preserving the vessel to which he belongs or any other vessel, and takes all reasonable precautions to avoid injury to a submarine cable, such person shall not be deemed to have acted unlawfully and wilfully within the meaning of this section.

(4.) Any person who within or (being a subject of Her Majesty) without Her Majesty's dominions in any manner procures, counsels, aids, abets, or is accessory to the commission of any offence under this section, shall be guilty of a misdemeanour, and shall be liable to be tried and punished for the offence as if he had been guilty as a principal.

IV.—Article 4 of the schedule to this Act shall not apply to that part of a cable which is laid in a depth of water exceeding 100 fathoms, but nothing in the Convention or this Act shall take away, prejudice, or affect any right or remedy to which by law any party is or may be entitled otherwise than under the provisions of the Convention or this Act.

V.—(1.) It is hereby declared that the enactments of the Merchant Shipping Act, 1862, and the enactments amending the same, touching regulations as to lights and to signals and for the avoiding of collisions, shall extend to authorise regulations for carrying into effect Articles 5 and 6 of the schedule to this Act, within as well as without the territorial waters of Her Majesty's dominions, and regulations may be made, applied, altered, and revoked, and the contravention thereof punished accordingly under the said enactments, and section 6 of the Sea Fisheries Act, 1883, shall extend to the enforcement of the said regulations as regards sea fishing boats within the limits of that Act.

(2.) If any vessel engaged in the laying or repairing of a submarine cable to which the Convention for the time being applies, interferes contrary to the said regulations or articles with any vessel engaged in fishing, or if the operatons of any vessel in connection with any such submarine cable are wilfully delayed so as to interfere with sea fishing, the master of the vessel, or the owner thereof, if it appear that he was in fault, shall be deemed guilty of a breach of the said regulations and may be punished accordingly.

VI.—(1.) For the purpose of carrying into effect the Convention, a person commanding a ship of war of Her Majesty or of any foreign state for the time being bound by the Convention, or a ship specially commissioned for the purpose of the Convention by Her Majesty or by the Government of such foreign State, may exercise and perform the powers and duties vested in and imposed on such officer by any article in the schedule to this Act.

(2.) If any person obstructs any such officer in such exercise or performance, or refuses or neglects to comply with any demand or direction lawfully made or given by him in pursuance of this Act, such person shall be liable, on summary conviction, to a fine not exceeding fifty pounds, or to be imprisoned for a term not exceeding two months, with or without hard labour.

(3.) Any action, prosecution, or proceeding against any officer for any act done in pursuance or execution or intended execution of this Act, or in respect of any alleged neglect or default in the execution of this Act, shall not lie or be instituted unless it is commenced within twelve months next after the act, neglect, or default complained of.

(4.) In any such action tender of amends before the action was commenced may, in lieu of or in addition to any other plea, be pleaded. If the action was commenced after such tender, or is proceeded with after payment into Court of any money in satisfaction of the plaintiff's claim, and the plaintiff does not recover more than the sum tendered or paid, he shall not recover any costs incurred after such tender or payment, and the defendants shall be entitled to costs, to be taxed as between solicitor and client, as from the time of such tender or payment.

(5.) Every such action shall be brought in one of Her Majesty's superior Courts in the United Kingdom (which Courts shall have jurisdiction to try the same wherever the matter complained of occurred), or in a Supreme Court in India, or in a Court exercising in a British possession the like authority as the High Court of Justice in England, but in no other Court whatsoever.

VII.—Part X. of the Merchant Shipping Act, 1854 (which relates to legal procedure), and the enactments amending the same, so far as unrepealed, shall have effect as if enacted in this Act, and offences under this Act may be tried, and fines under this Act recovered accordingly, save that nothing in the said part shall authorise the award of any punishment not authorised by this Act, or the summary prosecution of any indictable offence under this Act.

VIII.—(1.) Any document drawn up in pursuance of Article 7 or Article 10 of the schedule to this Act shall be admissible in any proceeding, civil or criminal, as *primâ facie* evidence of the facts or matters therein stated.

(2.) If evidence contained in any such document was taken on

oath in the presence of the person charged in such evidence, and such person had an opportunity of cross-examining the person giving such evidence, and of making his reply to such evidence, the officer drawing up such document may certify the said facts, or any of them.

(3.) Any document or certificate in this section mentioned purporting to be signed by an officer authorised to act under the schedule to this Act for carrying into effect the Convention, shall be admissible in evidence without proof of such signature, and, if purporting to be signed by any other person, shall, if certified by any such officer to have been so signed, be deemed until the contrary is proved to have been signed by such other person.

(4.) If any person forges the signature of any such officer to any such document as above mentioned, or makes use of any such document knowing the signature thereto to be forged, such person shall be guilty of a misdemeanour and liable on summary conviction to imprisonment for a term not exceeding three months with or without hard labour, and on conviction on indictment to imprisonment with or without hard labour for a term not exceeding two years.

IX.—Where any offence against this Act has been committed by means of a vessel, or of any boat belonging to a vessel, the master of such vessel shall until some other person is shown to have been in charge of and navigating such vessel or boat, be deemed to have been in charge of and navigating the same, and be liable to be punished accordingly.

X.—The provisions of this Act shall be in addition to and not in derogation of any other provisions existing at common law or under Act of Parliament, or under the law of a British possession for the protection of submarine cables; and nothing in this Act shall prevent any person being liable under any Act of Parliament, law of a British possession, or otherwise to any indictment, proceeding, punishment, or penalty other than is provided for any offence by this Act, so that no person shall be punished twice for the same offence, and nothing in this Act, nor any proceedings with respect to any matter, shall exempt a person from any liability in any action or suit with reference to the same matter, so that no person shall be required to pay compensation twice in respect of the same injury.

XI.—This Act shall, so far as such extension is consistent with the tenor of this Act, extend to the whole of Her Majesty's dominions, and to all places within the jurisdiction of the Admiral of England, and to all places where Her Majesty has jurisdiction.

XII.—In this Act, unless the context otherwise requires, the expression "vessel" means every description of vessel used in navigation in whatever way it is propelled; and any reference to a vessel shall include a reference to a boat belonging to such vessel; the expression "master" includes every person having command or charge of a vessel; the expression "British possession" includes any part of Her Majesty's dominions, exclusive of the United Kingdom; the expression "person" includes a body of persons corporate or unincorporate.

XIII.—This Act shall come into force on such day as may be fixed by a notice in that behalf published in the *London Gazette*, and if the convention ceases to be binding on Her Majesty, shall cease to be of any effect.

ON THE STANDARD OF ELECTROMOTIVE FORCE.

THE Edison and Swan United Electric Light Company, Limited, has now accumulated evidence to a very large extent which indicates the very great degree to which the average life of incandescence lamps depends upon the electromotive force or pressure at which they are used.

If a lamp is made to burn at 100 volts, its life is very considerably lengthened by being used at 97 and 98, and very considerably shortened by being used at 103 or 104. It is, therefore, of the greatest importance that the company, as manufacturers of incandescence lamps, should secure an absolute identity of standard, in order that divergency of reckoning may not exist between it and its customers, owing to errors and discrepancies between the scale readings of the various voltmeters in the market.

It is not sufficient to be within 2 or 3 per cent. The desirable thing to be attained is that voltmeters all over the United Kingdom should agree to within $\frac{1}{4}$ per cent., and customers would then be certain that the pressure under which they were burning a lamp is the same pressure as that marked on it as its proper or normal electromotive force.

There is another cause of discrepancy in existence other than errors in existing voltmeters, and that is the ambiguity about the standard itself.

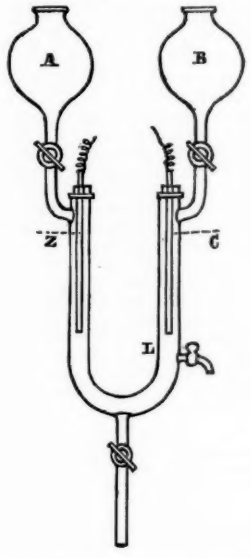
The directors, therefore, consider it advisable to make known to their customers the standard of electromotive force which is used in their lamp factory in the standardisation and testing of lamps, in order that users of their lamps may be in a position to check their voltmeters and to arrive at an identity of measure.

They now, therefore, advise all their customers that the standards and standardising instruments now in use at their lamp factory are as follows:—

1. The standard of electromotive force is the legal volt as defined by the Paris Congress of 1882.

The standard of resistance is the legal ohm.

2. The actual standard of electromotive force is a Daniell's cell employing metals and solutions selected by Sir William Thomson, and set up in the following manner in the form of cell devised by Dr. Fleming:—A is a reservoir of sulphate of zinc, B a similar reservoir of sulphate of copper, Z a rod of pure unamalgamated zinc, C a rod of pure copper freshly electrotyped, and L is the level of demarcation of the liquids.



The solutions used are a pure solution of zinc sulphate of specific gravity 1·4, and a solution of pure copper sulphate of specific gravity 1·1 at 15° C.

The metals used are pure unamalgamated zinc and copper *freshly* electrotyped.

The exactness of the electromotive force depends greatly upon the solutions being of the exact specific gravity above mentioned, and upon the copper rod being freshly electrotyped with a thin pure layer of unoxodised copper the instant before using.

The electromotive force of this cell is 1·072 volts true at 15° C., and may be taken as very approximately to represent the same value in legal volts.

3. The instruments used for comparison of this standard with the working pressures are Sir William Thomson's graded galvanometers.

The potential galvanometer must be set up in the place it is going to be used, and the value of its scale readings determined by this standard cell, and from time to time checked as the controlling magnet alters its value slightly with time.

The company will shortly be prepared to furnish standards of resistance, or legal ohms, and to issue standard cells of the above pattern for use in calibrating graded galvanometers, and full instructions for setting up the cell and working it will be sent with it.

The Retort Courteous.—An advocate of gas complained that the electric light was so poor in his city that he had been requested by young ladies to be their escort through the dark streets. The electric light man rejoined with the statement that the champion of gas was so handsome and fascinating that the reason the ladies desired his company was on the score of gallantry, and not of poor light. As there was no satisfactory answer to this, the discussion ceased with electricity ahead.

NOTES.

The Electric Light in Coal Mines.—It is very satisfactory to see that this subject is being taken up with vigour in Yorkshire, one of the Low Moor Coal and Iron Company's pits having been lighted by incandescent lamps. In this case not only are the main roads and pit bottom lighted, but the light has been carried right to the working faces. At the bottom of the shaft a main hauling road runs to the end of the pit a distance of some 150 yards, while parallel with this another road runs for the same length, turning off at the extreme end for about 130 yards at right angles. The working faces of the pit are reached by gangways running at right angles with these roads at distances varying from 50 to 60 yards. The dynamo, a "Blakey-Emmott" $2\frac{1}{2}$ unit compound wound is fixed with a small engine at the bottom of the shaft, and the cables are run down one of the main roads, while branches are taken therefrom direct to the workings, passing first through a switch which is hermetically sealed. Sufficient slack of wire is provided outside the workings to enable the miner to place his lamp wherever it may be required. The lamp is covered with a thicker glass shade and also with a wire screen to reduce the risk of breakage to a minimum. Down each of the main hauling roads lamps are fixed and controlled by a switch at the dynamo, the facing lamps being controlled by the smaller sealed switch already named, so that each man on leaving work can turn his light out on reaching the main road. The work has been carried out by the Crossley Telephone Company, Limited, of Albany Buildings, Bradford, which is devoting special attention to electric lighting.

Electric Lighting for Ships.—Mr. Kendall, one of the managing directors of the Peninsular and Oriental Steam Navigation Company, speaking at the trial trip of the latest addition to the company's fleet, on Saturday last, said:—"Sometimes I have heard the Peninsular and Oriental Company twitted with being very late in the field to adopt any new invention. When the paddle-wheel was superseded by the screw, we were said to be the last to adopt it; but we adopted it to very great purpose. The same has been said of the electric light, we will say. Well, now, a friend of mine took a passage on board an Atlantic liner which was fitted with the electric light when it first came out. I think it was one of the first ocean-going steamers fitted with that light. Everything was delightful for the first two days. On the third evening there was no electric light—there was no light at all; and no provision had been made for the light failing; but a few candles stuck in the ends of ginger-beer bottles were the only light enjoyed until the ship reached New York. Well, it has been our wish and hope—and I think our experience—to provide against failures of that kind. We have now the electric light fitted in a number of our ships, and on no single occasion has there been a failure."

Electric Lighting and Heat.—Hot weather has been prevalent in America recently, as well as in this country, and the New York *Sun*, which uses the Edison electric lighting system, emphasises the superiority of the electric light over all other means of artificial illumination, as follows:—"In common with others who use its light, we have been entirely content with the regularity and steadiness of this company's service, and the comfort our employés have experienced during hot weather in being relieved of the blaze of gas is of itself a sufficient compensation for the slight excess of the cost of the light over that of gas." Were the incandescent lamp in more general use in private houses, the long, hot summer nights might be spent to much greater advantage than they now are. That fact is being gradually found out.

The Leeds Electric Lighting.—The misunderstanding between the Corporation of Leeds and the contractors for lighting the New Municipal Buildings has been smoothed over. Why, however, such a *contretemps* should have occurred, the corporation having had the advice of a consulting engineer throughout, is the natural question suggested by the incident. If the report of the engineer to the corporation were favourable, what else was required?

The Electric Light in Stores.—The cold air stores in Charterhouse Buildings, recently built by Messrs. John Bell and Sons, are lit throughout by the electric light. The official trial of this installation has just been completed, and the conditions, which were somewhat unusual as regards the accumulators, were amply met. The cells were to be capable of working a proportion of the lamps for 16 hours, to be recharged in 8 hours and then supply the lights for 16 hours, the dynamo being driven from the air compressors. The installation was put up by the Electrical Power Storage Company.

Isolated Electric Lighting in Manchester.—We have it on the authority of the *Mechanical World* that it is probable that the tender of the Manchester District Edison Electric Light Company for lighting the Royal Institute in Mosley Street, Manchester, will be accepted. It is proposed to employ two gas engines and Elwell-Parker dynamos.

City of London Electric Lighting.—The *Echo* asserts that the influence which the price of coal gas exerts in preventing the introduction of the electric light for the illumination of the streets in this country is well seen by comparing the figures relating to the number of installations in the United States and Canada; and further remarks that some members of the Corporation of London, not content with the rather costly experiments of a few years ago, have succeeded in getting the subject of electric lighting referred generally to the Streets Committee for consideration and report, with the idea that the committee should themselves undertake the experimental lighting of a small area. There are portions of the City which are admirably adapted for electric lighting, and in which it might be employed to the benefit of the public; but with coal gas at its present price the Corporation must pay the extra cost, and it would be cheaper in the long run to have a tolerably large installation than one covering only a small area at a cost "not to exceed £1,500." If the Corporation had in the first instance tackled the matter in a proper way, they would have saved a good deal of the money lost by "shareholders."

The Mechanical Telephone.—Mr. W. J. Millar, C.E., who is well known in connection with his researches on the mechanical transmission of sound, writes thus to the *Scotsman* of 30th July:—"Having observed in to-day's *Scotsman* a notice of some experiments with a non-electric telephone, noted as an American invention, I may say that about seven years ago I carried out a number of experiments on the mechanical transmission of sound by wires, and gave a summary of the results in a paper to the Physical Society of London in March, 1878. Some very interesting results were obtained, and I found no difficulty in transmitting messages through wires laid from room to room of a house. I tried wires of different metals but got the best results with copper. Various materials were tried for the transmitting and receiving discs; cardboard set in deepish rims answered very well. For transmitting musical sounds no disc was required, the wire picking up the sound itself. The string of the toy telephone sold some years ago acts on the same principle as the wire, and I am told such telephones are well known in Spain and some parts of India. The wire, however, is more suitable for practical purposes, but as the range is short the electric telephone has a decided advantage."

Telephonic Extensions in Scotland.—At a special meeting of the Road Trustees of the Irvine District Committee, it was agreed to grant the application of the National Telephone Company for permission to erect poles on the roads in Irvine district to carry trunk wires connecting Kilmarnock, Troon, Irvine, Ardrossan, and Ayr, with Glasgow, provided that the work was done to the satisfaction of the surveyor. The company agreed to pay 6d. per pole or post, as a way-leave, for every pole or post put up on the roads by them.

Submarine Telegraph Cables Bill.—The Lords amendments on this Bill were considered in the House of Commons on Thursday evening, the 30th ult., and agreed to.

Suakim Cables Broken.—Amongst other disadvantages which the troops left at Suakim are labouring under, it is stated that the town is now cut off from telegraphic communication, both the cables being broken.

The First Atlantic Cable.—Mr. Cyrus W. Field celebrated the 27th anniversary of the laying of the first Atlantic cable, on Wednesday night, by a complimentary dinner to about 200 distinguished personages, at the Star and Garter Hotel, Richmond. Mr. Field presided, and amongst those who were present we notice the names of Sir Lyon Playfair, M.P., Mr. G. Shaw-Lefevre, M.P., Sir James Anderson, Sir Charles Bright, Sir William Thomson, Sir Henry Thompson, Sir George Elliott, M.P., Sir Daniel Gooch, M.P., Sir Julian Goldsmid, M.P., Sir Arthur Otway, M.P., Vice-Admiral Sir George Richards, M.P., Mr. H. Reuter, and many others. The loyal toasts, English and American, having been honoured, the chairman gave "Success to the Atlantic cables; may they perpetuate the peace, friendship, and prosperity of two great kindred nations." He gave in brief terms the history of the difficulties encountered in laying the first cable, and described the success eventually achieved. They had covered both earth and sea with a subtle and instantaneous means of inter-communication, which was destined, in its far-reaching consequences, to bind together all the great English speaking family, and to play an important part in advancing the general well being and progress of mankind. Senator Hawley, of Connecticut, Sir George Elliott and Sir James Anderson responded, after which, the chairman proposed the toast of "The men of science and enterprise, to whom submarine telegraphy in so largely indebted," coupling with the toast the names of Sir Wm. Thomson and Sir Charles Bright. The "Health of the chairman," proposed by the Lord Mayor, brought the proceedings to a close.

A Pacific Ocean Cable.—The following curious remarks are from the pen of the San Francisco correspondent of the *Electrician and Electrical Engineer* of New York:—"What a boon to commerce, and what a source of general satisfaction to the reading people of the world would a cable from the Pacific Coast to China be; say along the 40th parallel to the Japanese Islands and Shanghai. In this way we could have pure and unadulterated war news, which must now be taken with considerable allowance after passing through the sieve of a British censorship. This cable was contemplated some eight or nine years ago, and the U.S. steamer *Hassler* took soundings, but because it did not promise an abundant return for the money to be expended it was allowed to drop. In a few years when Russia will control the Persian Gulf and the Sea of Oman, she may unite with China in establishing direct cable communication with the Western Hemisphere unless England forestalls her by connecting Victoria, B.C., with Yeddo, Japan. England very seldom unites with other countries in promoting any scheme for the public good, unless she is to derive the greatest benefit therefrom."

The Telegraphic Conference. — The Home Trade Committee of the Liverpool Chamber of Commerce has addressed a letter to the Postmaster-General and to the Secretary of State for India asking that it might be permitted to send a representative to the International Telegraph Conference to be held at Berlin on the 10th instant. The committee is of opinion that previous conventions arising out of such conferences have contained rules causing great inconvenience and expense to firms using codes in telegrams.

The *Financial News* remarks that it is rather unfortunate that, at the Telegraph Conference, which opens at Berlin on Monday next, the British representation should be confined to officials from the Post Office. English capital has provided more submarine wires than the capital of all other countries combined, and while it may be within the province of Germany to submit suggestions as to land wires on the Continent of Europe, there ought to be more opportunity for the great cable companies of England to make themselves heard than seems at present to be in contemplation.

The proposals which the German Postal Telegraph Administration will submit to the International Telegraph Congress, which opens next Monday, are in substance as follows:—The tariff for inter-European telegrams to be 50 centimes for a first charge (*grundtaxe*) and 20 centimes for each word. For telegrams forwarded by submarine cables an additional charge may be made not exceeding 10 centimes per word. The transit rate for land lines for Belgium, Bosnia, Herzegovina, Bulgaria, Denmark, Greece, Luxemburg, Montenegro, Norway, the Netherlands, Portugal, Roumania, Servia, and Switzerland, to be two centimes per word; for Germany, Austria-Hungary, Spain, France, Great Britain, Italy, Russia, Sweden, and Turkey four centimes per word. The last-named rate may be reduced to two centimes by the Telegraph Administration which effects the transit. The rate for submarine cable telegrams to be for 300 miles five centimes, and for greater distances 10 centimes per word. Transit rates, whether by land lines or submarine cable, in no case to exceed those in force at the present time.

Sixpenny Telegrams.—At length we are assured of having the long sought for sixpenny telegram, and October 1st next will see the inauguration of the new system. Extensive arrangements have been long since made, and there is but little doubt that the Post Office Telegraph Department will be found ready to grapple with the increased traffic which will certainly result from the cheapening of the rate. The lines in all directions, and in most localities, have been increased and extended, and operators and instruments have been waiting for the work to come to them. So far as the department is concerned, therefore, everything may be expected to be carried out satisfactorily. As to the use the public will make of the new facilities offered for telegraphing, it is by no means easy to predict how far those who have hitherto refrained from sending a telegram on account of the expense will consider themselves justified in the expenditure of sixpence for the purpose. Undoubtedly, it is to this class that the department must look for any considerable increase in its revenue, for the only difference, probably, which the new tariff will make to the bulk of those who have up to the present constituted the backbone of the telegraphing community, commercial men of various grades, will be that they will be able to send the same number of messages—rapid transmission of which is imperative, whatever the tariff—at half the expense.

Telegraphic Addresses.—Mr. W. J. Stillman, writing to the *Times*, suggests a method of simplifying the addresses of telegrams by numbering all the streets, places, squares, &c., with progressive numbers. His suggestion appears to be very similar to that of Dr. Cameron, to which we have before alluded, and which we have advocated as useful and easily feasible. Mr. Stillman says:—"A small directory with the streets alphabetically arranged and opposed by consecutive numbers will give any address in a single group of figures of at most five characters, and the

absurd custom of giving high-sounding names to individual houses would in most cases give place to numbers, so that the address might be simply given in three words—thus, Brown, 25, 5672. The telegraph clerk, turning to this directory, will be able to write the name of the street from it instead of the number in the telegram. For the convenience of the telegraphic operators the telegraphic station which serves the street might be indicated by a letter, or combination of letters, in the directory. The sender of a telegram who had not provided himself with a copy of the directory would find at each station a copy from which he would get the number of the street he wishes to address to and fill it into his form, the address standing, when complete, thus: Brown, 25, 5672 *ah*, the *ah* standing for the number of the telegraph station; or this may be given, if no confusion is likely, in plain numbers, but, being only for the guidance of the operator, should not be charged for or added to the address sent out. In this case the address would stand, Brown, 25, 5672, 34. This leaves seven words for the message, which, supposing the *minimum* to be 10 words, is very liberal. This need not prevent the rational designation of the streets of London, which would, however, be a longer process, and does not depend on the Post Office."

Telegraph Acts Amendment Bill.—In reply to Mr. Alderman Lawrence, in the House of Commons on Friday, 31st ult., Mr. Shaw-Lefevre said that the question whether several figures were to be counted as one word in a telegram would not be dealt with by the Telegraph Acts Amendment Bill, but would be left to the Post Office regulations. With respect to the substitution of a half-penny per word rate in place of one penny for two words, he should move to recommit the Bill for the purpose of introducing an amendment making that alteration. This would also give the hon. member for Blackburn an opportunity of moving the amendment which he withdrew last night on the understanding that it could be moved on report. In answer to further questions, Mr. Shaw-Lefevre said he could not consent to the names of streets, roads, terraces, or of islands in addresses being treated as one word. Replying to Mr. Puleston, Lord J. Manners said that the officials of the department had informed him that the substitution of a half-penny per word rate instead of a rate of two words for a penny would not make any financial difference.

Lord John Manners informed Mr. Alderman Lawrence, on Monday, that it was hoped that the Act reducing the price of telegrams would come into operation on October 1st.

In the House of Commons, on Tuesday, Lord Mount-Temple, in moving the second reading of this Bill, which had passed the Commons, said that it would confer a very considerable boon upon those persons who were now obliged to pay for twenty words when their messages contained less than ten words. It was calculated that if the Bill passed there would be a large increase in the number of messages sent, and there was no doubt that the measure would be a very great advantage to the public at large. The Earl of Milltown wished to know whether the Government assented to the Bill, and whether the first section meant that the name and address of the sender must be upon the message. The Earl of Iddesleigh said that the Bill was introduced into the Commons by the late Postmaster-General. When it came on for discussion the present Postmaster-General proposed that it should be carried with an amendment of which he had given notice. His noble friend was defeated upon that, and thereupon left his predecessor to take charge of the Bill. So far as the Government were concerned, they looked upon the Bill as one for which the late Government were responsible. Lord Mount-Temple said he was requested by the late Postmaster-General to take charge of the Bill. He understood that the sum of sixpence was to be paid for any number of words not exceeding twelve, and the sender might put them either in the address or in the message. The Earl of Milltown said that in committee he would move an amendment in order to make the Bill more clear on the point raised by his question. The Bill was then read a second time. The Bill passed through committee on Wednesday, and was reported without amendment to the House.

Fatality to a Telegraphist.—At Luss, last week, two young men had gone out in the afternoon boating. One of them went in to bathe and was drowned. His name is Baxter, and he was connected with the Postal Telegraph Office, Glasgow. He was down at Luss on official duty. The body was recovered.

Overwork among Telegraph Clerks.—The *Lancet* is speaking out on behalf of the telegraph clerk, remarking upon the evidence afforded by the last estimates of the Revenue Department of the existence of nervous overaction and exhaustion. It appears from the report that rather more than half of the pensioned employés owe their retirement from duty to causes of this kind. The *Lancet* remarks:—"Four months ago we drew attention to the youth of many of the clerks, and the long-continued and nearly incessant daily labour of twelve hours in a not too wholesome atmosphere, as causes which must in many cases wear out the general physical machinery. Such causes are at work, we admit, in every large city, and in almost every calling. They are fruitful in producing that commonest of maladies which affect the overworked who follow a sedentary occupation—anæmia. Pure air and the use of their muscles are their best medicines. The telegraphist has, moreover, another and peculiar need, and in the want of provision for this we must look for the explanation we desire. His work is mental, and it is also monotonous. It involves long harping on one chord of his intelligence, with but little intermission and little variety. We have frequently to do, therefore, with a badly nourished brain, subject to sustained impulses passing along the nerve of hearing, and obliged, by concentrated and generally uniform effort, to convert these into visible expressions. Thus the brain, losing the exercise of invigorating reflection, and acting merely as a higher reflex centre, is apt to be driven to exhaustion by sheer wear and tear of certain lines of its nervous tissue. A shorter working time for the individual, with some interchange of functions from time to time between the members of the staff, would probably reduce the length of the telegraph pension list, and would also increase the efficiency of the department by perfecting the technical knowledge of each official."

Might is Right.—Mr. Jay Gould, of the Western Union Telegraph Company, imagining himself justified by a decision in the law courts, recently seized (or is credited with having authorised the seizure) the wires of the Bankers and Merchants' Telegraph Company, running them into his own offices. An interesting state of things is now proceeding, somewhat as follows:—"All the wires of the Bankers and Merchants' Telegraph Company, at Albany, N. Y., were cut a second time by the Western Union at 3 o'clock in the morning. After they were cut on Friday night the Bankers obtained possession again and held them during the day. Guards were placed at the pole where the connections were made, so that the Western Union could not approach. Early the next morning, however, the guards were caught napping, and a Western Union employé quickly climbed the pole and cut the wire into the office. Two watchers sat astraddle the crossbar all day and during the night to prevent the Bankers and Merchants from again securing the lines. The office of the latter company has been closed."

Personal.—Mr. Theodore N. Vail and Mr. Madden are both leaving the American Bell Telephone Company. We last week announced that Mr. J. E. Hudson would be Mr. Vail's successor, and we now learn that Mr. C. Jay French, who has proved himself hitherto of efficient service to the company, will succeed Mr. Madden.

The British Association Meeting.—In connection with the forthcoming meeting of the British Association at Aberdeen, the Earl of Crawford and Balcarres has placed at the disposal of a local committee a number of rare books, selected from his library, and valued at £25,000, as the nucleus of a special library, to be available for the inspection of the *savants* during their visit to the city. Other noblemen in the district are to be invited to contribute the gems of their selections to the library, which will form a unique and interesting feature of the meeting.

London and Globe Telephone Company.—A meeting of the shareholders of this company was held at the Cannon Street Hotel on Wednesday, but, as we had anticipated, our representative was unable to gain admittance, the meeting being stated to be of a private nature.

The Salters Company and Technical Education.—At a meeting of the Court of the Salters Company, held on July 31st, it was agreed to raise its annual subscription to the City and Guilds of London Institute from £525 to £1,000, payable in moieties during the pleasure of the Court.

Advantage of Electric Lighting to Cities.—The New York *Sun*, commenting on the position taken by a Cleveland paper against the lighting of city streets by electricity, on account of the expense, remarks: "Here in New York, while electric light doubtless costs more than gas, we don't believe that it will be abandoned for that reason. In important avenues and large public squares the brilliant illumination of electricity adds to the public safety as well as to the public convenience, and we are confident that it will be maintained. Besides, some man may come along presently whose inventions may reduce the cost. Electric lighting is probably a permanent institution for all large American towns."

Cable Communication between the United States and Brazil.—A despatch from Buenos Ayres, we learn from the New York *Electrician and Electrical Engineer*, says that Minister Osborn, acting in accordance with instructions received from the State Department, Washington, has concluded a contract securing to the Central and South American Telegraph Company a concession to establish cables between Buenos Ayres and Rio Janeiro and land lines between Buenos Ayres and the Pacific side, thus securing to an American company continuous and independent telegraphic communication between the United States and Brazil. The necessary decree has been signed by the President of the Argentine Republic.

The Direction of Lightning.—Mr. William Allman, writing to *Knowledge*, says:—"Several years ago, late in summer, and in the dusk of evening, I was on an open vehicle on a very exposed road, when a hailstorm came on, to protect myself from which I put up my umbrella, and as the wind was at my back some of its ribs necessarily pointed upwards, whereupon they immediately became tipped with the most beautiful pencils (*not stars*, mind you) of electric light I ever saw, affording thereby conclusive proof of the *direction* of the current. Which being so, it now rests with those who deny that lightning ever strikes *upwards* to show, if they can, how it happens that what is possible under a *weak* electrical tension is "impossible" under a *strong* one. N.B.—In the great thunderstorm of June, 1846, which heralded the potato failure in Ireland, the direction of the flashes of lightning was, mostly, neither up nor down, but horizontal." The Editor of our interesting contemporary remarked upon this that "the phenomenon witnessed by Mr. Allman was the ordinary brush discharge familiar to all users of a frictional electrical machine. What I understood the Conductor of *Knowledge* to deny was, not that lightning strikes upwards, but that *it is impossible for the observer to see this.*"

A Model Central Station.—A New York contemporary remarks that although a city of but 25,000 inhabitants, Williamsport, Penn., has shown great interest in electric matters. In order to establish an electric lighting system $100,000 was raised for the erection of an Edison central lighting station of the most approved and substantial form. It is a large brick building equipped with two 180 H.P. and one 140 H.P. Buckeye engines, and four large steel boilers equal to 500 H.P. The engines were set up with the greatest care, running the dynamos direct, and it is spoken of as the model central station in the country. There are nearly 4,000 10 candle-power lamps, which are furnished at about the same price as gas, at $2.00 per 1,000 feet. The new station was started October, 1884, and has been increasing gradually ever since. The meter system was abandoned, and special contracts made shortly after the station was started. The lines are all well and substantially built, all overhead, or pole lines. The plant has a capacity of about 8,000 lamps, which number no doubt will be subscribed for in due time. The company has made a proposition to the city council for the street illumination, which is to be awarded soon.

Secondary Batteries for Street Cars.—A successful test of the secondary batteries made at Baltimore as a motive-power for city and passenger railways was made on July 15th on the Union Passenger Railway. Among those who went out on the trial trip were Messrs. James R. Clarke, president of the Viaduct Manufacturing Company, the manufacturers of the batteries; A. H. Bauer, the electrician of the company, under whose direction the practical test was accomplished; W. W. Donaldson, assistant electrician; H. A. Foster, the electrician for the Daft Electric Company, of New York, whose motor was used in connection with the storage battery; and T. C. Robbins, superintendent of the railway company, who allowed the use of his motor, tracks and cars for the experiment. Eighteen persons were in the car, which, with the weight of the car, motor, &c., made a total of 5½ tons. The car moved out of the yard, passing over grades of 235 feet to the mile and around curves 75 feet radius with ease and comfort. The batteries used on the occasion were simply the ¼ horse-power, not even made for motive-power, but for incandescent light. But Mr. Bauer, the electrician, after figuring out the subject, decided that with these small boxes a street car could be safely run, as was fully demonstrated. Forty-nine of the little ¼ horse-power boxes were placed in the cab and connected with the Daft electric motor. On level grades only 29 of these boxes were used, the loaded car making easily six miles an hour. On the 235-feet grade the 49 boxes were used, equal to 8·6 horse-power.

Experiments on the New Jablochkoff Battery.—This battery, says the New York *Electrical World*, which was described in one of our late issues, has been subjected to a series of tests by our London contemporary, the ELECTRICAL REVIEW, and the result is given below. . . . . This would seem to indicate that the Jablochkoff battery is no improvement over the ordinary form, and, indeed, remarks our contemporary, a critical analysis of the element fails to convince us of its alleged superiority.

Holroyd-Smith's Electric Tram-Car.—The electric tram-car belonging to Mr. M. Holroyd-Smith now running at the Inventions Exhibition carried 2,202 passengers on Monday. This car is one of those intended for the Blackpool tram line.

The Institution of Mechanical Engineers.—At the summer meeting of the Institution, held at Lincoln this week, Mr. Ralph H. C. Neville, of Wellingore Hall, read a paper on "Private Installations of Electric Lighting."

The Blackpool Electric Tramway.—The Board of Trade, acting on the report of its inspector, Major Hutchinson, has declined to permit the opening for passenger traffic of the Blackpool electric tramway, which is laid along the Promenade, on the ground of its faulty construction. This is much to be regretted. and we hope to hear that before long all such difficulties will have vanished.

The *Blackpool Times* is very severe upon the Corporation of that town for mismanagement in connection with the construction of the electric tramway. It says the real blunder was made at the outset, when it was resolved to construct the lines under the supervision of a gentleman whose experience of tramways was *nil*. The *Times* does not greatly blame the contractor. If his work was bad he ought to have had the fact pointed out at the very first. If he declined to take notice of the suggestion, then the engineer in charge should have reported to the proper committee, the committee should have referred the matter to the full council, and the council should have stopped the supplies, or declared the contract at an end. There is certain to be a direct loss to the ratepayers, as the first estimate for the lines will unquestionably be exceeded, and our contemporary counsels the advisability of making the first loss the only one, by boldly grappling with the business at once. It seems the points are not what they should be, the electrical engineer having asked for points of a certain number, whilst the Corporation official insisted upon those of quite a different figure. The tramways committee is advised to order all these up right away, when a resolute effort might see a fairly quick completion reached and the cars running before the season is over.

Electric Signalling from a Balloon.—The following correspondence upon this subject appeared last week in the pages of our contemporary, *Invention*:—Mr. James W. Vickers, writing from Liverpool, said: "I have read with much pleasure your interesting account of Bruce's experiments in electric signalling from a balloon. The manner in which Mr. Bruce illuminates his balloon is precisely similar to that which Mr. B. H. Thwaite, C.E. (the well-known chemist and engineer), described to me some four months ago. I am pleased to see the experiment so successful, but honour to whom honour is due. I feel prompted to mention that the method of illumination is distinctly that invented by Mr. Thwaite."

"J. H.," of Leeds, wrote: "Mr. Bruce's method of signalling by electrically illuminated balloons is certainly not original. I remember my friend, Mr. B. H. Thwaite, described a similar scheme, which he proposed laying before the military authorities some five months ago, for use in the Soudan campaign. His scheme was, however, more for strategetic purposes than for signalling. Although wishing Mr. Bruce the fullest measure of success in his experiments, I think it is fair to mention that to Mr. Thwaite is due the honour of proposing the electrical method for illuminating balloons."

Nickel-Tipped Thunder-Rods.—"You see,'" said the farmer to the lightning-rod agent, "it ain't lightnin' that I'm afraid of, it's thunder. Thunder allers paralyses me. I don't want no lightnin' rods." "Well," admitted the agent, "I think myself that thunder is the more dangerous of the two. What you want is thunder-rods." "Have you got thunder-rods?" "Oh, yes; the brass-tipped rods are for lightning, and the nickel-tipped for thunder; but the latter cost a little more." "I guess you kin put up a few of them thunder-rods," said the farmer. "I don't mind payin' a little extry so long as I feel safe."

The "Great Eastern" Steamship. — Mr. Justice Chitty, on Monday, refused to interfere with the order to sell this ship, and dismissed the summons brought by the Great Eastern Syndicate, who asked that no order for sale might be made except subject to the terms of their charter party.

Secondary Generators or Transformers.—The apparatus constructed by Messrs. Zipernowski and Déri appears to be a considerable advance upon the now generally known induction coils of Gaulard and Gibbs, and their method of application for distributing electricity seems also less liable to mishaps or to variations in supply. Still, it is difficult to see the general utility of such appliances as compared with the advantages to be derived from the employment of secondary batteries.

Technical Education.—The Report of the City and Guilds of London Institute for the Advancement of Technical Education is just published. It contains particulars of the seventh annual examination in technology. The candidates examined have increased from 3,635 in 1884 to 3,968 in 1885, and the number who have passed from 1,829 to 2,168. These examinations have taken place in 47 subjects, and from the returns furnished in November last, it appears that 6,396 persons were receiving instruction in the registered classes of the institute, as compared with 5,874 in the previous year. Complaint is made by the examiners as to the inability of the majority of the candidates to make intelligible sketches. It is hoped that this defect in the education of artisans will be gradually remedied as linear drawing comes to be more generally taught in the public elementary schools. The percentage of successful candidates to whom this year full certificates will be awarded, has increased from 31·2 last year to 34·5.

The Course of True Love, &c.—Without being able to speak from experience, we are given to understand that electrical men are proverbially fickle in the affairs of the heart, and Mr. Allan Cairns, of the Scottish branch of the India Rubber and Gutta Percha Company, appears to be no exception to the rule. This gentleman, whose amatory effusions to the lady of his choice were of the most passionate and endearing character, has just been mulcted in the sum of £75 for declining to carry out his part of a "joint" compact for making a "splice." Perhaps it was that the tender passion influenced his young and susceptible mind, or it may be that he felt the inspiration of natural genius; at all events his correspondence, from which we quote the following lines, written on the eve of his departure for Gibraltar, shows most conclusively that he has mistaken his vocation in life:—

"Dear Nellie, forgive me for such a short letter,
In the time that's allowed me I cannot do better
Than say good bye, dearest Nellie, for a few days or so,
By that time I will write and the news you shall know.
From the Rock a long letter I'll send unto you,
Till then, sweetest Nellie, I must bid you adieu."

A Missing Areonaut.—Mr. F. A. Gower, of telephone fame, is causing much anxiety to his many friends. Mr. Gower had selected Hythe as the centre for his experiments, with the view of testing the adaptability of balloons to war purposes, and thence made several ascents. His final undertaking in this country was a successful aerial voyage across the Channel early in June. He continued his trial trips in France, and met with a misadventure while awaiting an opportunity of returning in a balloon to England. Undeterred by this, he made an ascent on the 18th of July from Cherbourg, and since that date nothing definite is known of his whereabouts. A pilot balloon which he had previously despatched has been found and sent on to Hythe; and a balloon has been picked up without a car some 30 miles off Dieppe. Nearly three weeks having now elapsed since the ascent, and no message having been received from Mr. Gower, whose invariable practice it was at once to notify by wire his safety at either Cherbourg or Hythe, at both of which places he has left property, the gravest fears are entertained that he has been drowned. It may be mentioned that the experiments being carried on by Mr. Gower were within the cognisance of the Government, and have so far, it is believed, proved of a very satisfactory character.

Defences of the Canton River.—The late Chinese Minister to Berlin, in the early part of the month of June paid a visit of inspection to the forts and torpedo stations on the Canton River. Some good target practice was made with the 21 and 24 centimetre guns, and the large electric search lights of 36,000 candle-power, the largest in the East, were exhibited both at the Bogue forts and at Whampoa. His Excellency congratulated Mr. Betts, A. M. Inst. C.E. on the successful defence made of the Canton River, by which Canton had been spared during the late war.

The Fawcett Memorial.—The Fawcett Memorial Committee at Salisbury has selected Mr. Richard Pinker, of Kensington, from a number of competitors, to execute the statue to be erected in the city to the memory of the deceased Minister.

Bartholdi's "Liberty."—In connection with the scheme for providing a pedestal for the colossal statue of "Liberty" presented to the American nation by France, the *Newark* (*N.J.*) *Journal* has on exhibition at its office an exact reproduction of Bartholdi's great work, in bronze, standing upon a handsome mahogany case, containing an electric attachment. When a quarter of a dollar is dropped into the aperture at the base of the statue, a "cam" inside revolves, depositing the coin in a locked drawer below. At the same moment the cam presses a spring, which completes an electric circuit between a set of Bunsen cells beneath, and a minute Edison incandescent lamp, which Miss Liberty holds aloft in lieu of a torch. The torch flashes its tiny light for a moment at every coin that enters the drawer. The apparatus was kindly made for the *Journal* by Mr. William J. Hammer, of the Edison Company.

NEW COMPANY REGISTERED.

Mechanical Telephone Company, Limited.—Capital: £100,000 in £5 shares. Objects: To purchase from the Telephone Association, Limited, for £21,000 cash and £21,000 in fully paid shares, the letters patent, No. 9050, dated 17th June, 1884, granted for an improved mechanical telephone. Signatories (with one share each): W. F. Splatt, J.P., Torquay; W. H. Williams, 12, Bishopsgate Street; J. Bailey, 4, Cutbill Road, Denmark Hill; W. Harding, 67, Crayford Road, Tufnell Park; J. G. Pyle, 7, Lamell Street, Stoke Newington; L. J. Langmead, 2, Violet Villas, East Dulwich; O. Fitzgerald, Sunnyside, Teddington. Directing qualification: £500 in shares or stock. Remuneration; £600 per annum, and when the dividend upon the ordinary shares exceeds £15 per cent. per annum, a further sum equal to one-tenth part of the sum divided as dividend. Registered 31st instant by Messrs. Hillearys and Layard, 5, Fenchurch Buildings.

Mayall, Limited.—Capital: £50,000 in £5 shares. Objects: To acquire the photographic business of Mr. J. E. Mayall, of New Bond Street and King's Road, Brighton, in conjunction therewith to carry on the business of electricians in connection with photography, as well as the various purposes for which electricity is available. Signatories (with one share each): H. W. Spratt, 40, Queen Victoria Street; S. C. Fox, Wellington Road, Enfield; J. S. Low, 29, St. Lawrence Road, North Kensington; Edu Balen, C.E., 11, Ryder Street; J. J. North and T. G. Pearce, 1, Gresham Buildings; Edward Schubert, 32, St. Swithin's Lane. The signatories are to appoint the first directors; qualification 20 shares. The remuneration of the board will be at the rate of £100 per annum for each director. Registered 5th inst., by Messrs. Blackford, Roches and Co., 25, Abchurch Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Western Counties and South Wales Telephone Company, Limited.—An agreement, dated 27th ult., was filed with the documents of this company on the 1st inst., under which the company will issue to the United Telephone Company 3,400 fully paid preference shares, in satisfaction of £17,000 due to the latter company.

LEGAL.

Liardet and Another v. The Hammond Electric Light and Power Supply Company, Limited.—The plaintiffs in this action, tried before Mr. Justice North, were Messrs. John Evelyn Liardet and Thomas Donnithorne, and they sued the defendants for £45,000 damages for breach of certain covenants in an agreement under seal of June 17th, 1882, and specific performance of the remainder of the agreement. By that agreement the plaintiffs contracted to sell to the company three patents—namely (1), a patent of November 29th, 1884, for hydraulic motors applicable for the production of electric light; (2) a patent of December 10th, 1884, for an arrangement of electric lighting apparatus in railway trains; and (3) a patent of January 9th, 1884, for an apparatus for storage of electricity. The price was to be £30,000 in cash and £15,000 in fully paid shares, £6,000 being paid in cash as a deposit on the signing of the agreement, and the completion of the contract was expressly made subject to the following conditions:—(1) "The vendors shall prove that the accumulators made under the accumulator patent are, as against the Faure accumulator, practically half the weight and half the cost for equal power, and, further, that they are equal for commercial and practical purposes to the Sellon and Volckmar systems; (2) the said proofs shall be given on or before the 1st of December next. Immediately on failure of such proof the said deposit shall be immediately repaid to the Hammond Company." The plaintiffs alleged that they had performed their part of the contract, but charged the defendants with a refusal to complete. The defendants' case was that the plaintiffs had failed to give the proofs required by the contract, and that the experiments which had been made had fulfilled none of the conditions of the contract, and they claimed a return of the deposit without any deduction for the expenses of the experiments which had been made and the scientific opinions which had been taken. Mr. W. Barber, Q.C., and Mr. Macrory were for the plaintiffs; and the Attorney-General, Mr. Moulton, Q.C., and Mr. A. J. Ashton for the defendants. His Lordship, after hearing the evidence of Mr. Donnithorne, the only witness called on behalf of the plaintiffs, held that the proofs which were stipulated for had never in fact been given, and that it indeed appeared that without the use of another patent, the Sellon-Volckmar, which had been denied by the patentees to the plaintiffs, it was not possible to give them. That being so the action must be dismissed with costs, the plaintiffs must procure the return to the company of the whole of the deposit, and the company must take all necessary steps to enable the registration of the agreement to be cancelled at the Patent Office.

CITY NOTES, REPORTS, MEETINGS, &c.

Anglo-American Telegraph Company, Limited.

THE ordinary general meeting of this company was held at the Cannon Street Hotel, on Friday, the 31st ult., under the presidency of the Right Hon. Viscount Monck, chairman of the company.

Mr. T. H. Wells, the secretary, having read the notice convening the meeting,

The Chairman said: It now becomes my duty to move the adoption of the report, and in doing so I shall not adopt the plan which I have usually pursued, of comparing the figures of this half-year with those of either the preceding or past half-years, and for this simple reason, that the conditions under which we have been working during this half-year are so completely different to those which prevailed in former half-years that a comparison would be completely futile and useless. We have been operating during the past half-year under the influence of depression of trade, increased competition, and a diminished tariff. We have, also, in addition to these disadvantages, been specially unlucky with regard to our cables. I mentioned to you at the last half-yearly meeting that several cables belonging to our combination were out of order and not working. I regret to say that state of things has not been completely got rid of as yet; we have still two cables of the combination—one of the Jay Gould cables and one of the French cables—which are incapable of conveying messages across the Atlantic. Every effort, however, is being made to repair these cables, and I trust before long that the whole of our system will be in full operation. Now, gentlemen, it will be evident to you that this state of things places us at a very great disadvantage in more ways than one. In the first instance it increases our expenses by compelling us to do a larger than our proper share of the whole traffic, without any proportional increase in our income. In the next place, it ties our hands very much with reference to the competition, for it would be madness for any man or set of men to embark in a hostile competition or a war of rates, even if such a policy were deemed advisable when the weapons of our warfare were not in proper order. In addition to these considerations, it affects us in another

way. Our opponents have not had much experience of the working of ocean telegraphy, and of course they are very much guided in their views with reference to the future, and to their relations with us, by the receipts which they obtain. You are all aware, and I have noticed it from this place, that we have observed in our experience that there is a rule which regulates the distribution of traffic amongst competing cables, and which acts with almost the certainty of a natural law, giving to each cable competing its aliquot part of the traffic. From this it necessarily follows that the smaller number of cables there are in operation at any one period the larger the receipts of each will be, and, therefore, the Commercial Cable, as it is called—the Mackay-Bennett cable—is at this moment receiving a larger share of the traffic than they would do if all our cables were in operation. Well, gentlemen, all I can say is this, we are doing our best—and when I say "we" I mean our allies as well as ourselves—we are doing our best to place our plant in proper condition, and I trust that before long we shall be in a position, either by a hostile competition, if that should be considered desirable, or by the force of circumstances, to bring our opponents to a sense of reason, and to induce them to take steps which may enable us all to get a living. I am by no means despondent on the subject. I think such an arrangement can be come to. It is, of course, difficult to speculate what will be the conduct of men who, as far as our judgment goes, have already shown so much recklessness in expending such a large sum of money on telegraph cables when there was really no need for them. But I do not believe that they are so different from the rest of mankind as to forego all profit on their capital in the interests of pure philanthropy and cheap telegraphy. That being so, I trust before long we shall come to some arrangement which will enable us to give you a more satisfactory dividend than I am sorry to say we are capable of doing on the present occasion. I now come to our old friend, or enemy, whichever you may call it, the renewal fund; and, in opening my remarks on that portion of the case, perhaps you will allow me in all good feeling and good humour to say a few words in deprecation of the heated and angry tone which characterised the discussion of the subject on the last occasion in this room. (Hear, hear.) This is a mere matter of business and we surely can afford to discuss it without getting excited or using language which I am certain those who used it were sorry for after it took place. This question has been discussed as if your directors had some unworthy personal motive in the policy which they have adopted. I think, if you reflect for one moment, you will see that nothing but a stern sense of duty would have induced the directors to take up the position which they did take up. You may differ from them in opinion, but I am sure you will all allow that if they could conscientiously have done so it would have been much more agreeable to the directors, to use a slang phrase, to make things pleasant all round and to meet their constituents with smiling faces. We could not do that as men of business, as men of conscience and as efficient managers of your affairs. In the discussions it seems to me as if the contribution which we make to the renewal fund was adopted by mere rule of thumb, a mere chance shot at what would do to replace the cables. I assure you that was not the case. This sum was arrived at—and I may mention in parenthesis that this sum was approved by the shareholders. (Hear, hear, and No, no, no!) I beg the shareholder's pardon; I have always been the chairman of this company, and I remember perfectly what has taken place. It was approved of by the shareholders over and over again, and it was arrived at not by rule of thumb, but by elaborate calculations based on the best information we could obtain, and on the opinions of those who are most competent to advise us. I beg leave to say that, for myself, and I believe I speak the feelings of my brother directors, that no change has taken place, in my opinion, either as to the legal liability of the directors, which I have often stated from this place, or as to the general principles upon which our renewal fund should be based. There are two elements which we must consider in endeavouring to ascertain the annual amount to be set aside towards renewal. One is the duration of a cable in a state of efficiency; the other is the cost of replacing it. On these elements, of course, depends—it is a mere actuarial calculation—the amount which it is necessary to set aside for the renewal fund. With regard to the first of these elements, the duration of the efficiency of the cable, every year that a cable lies it gives you stronger faith in its continuance. But that is an element that is not capable of being very accurately measured in figures. The other element, the cost of replacing it, is one which is more capable of being measured in figures, and I am happy to tell them that on a careful reconsideration of the whole case your directors have discovered a mode in which a large economy can be effected in the replacing of your cables, which has enabled them so far to meet your wishes without sacrificing their own convictions, as this half-year, and in future half-years, to reduce the contribution towards the renewal fund, to £100,000 a year, that is to say, taking off £50,000 a year from the contribution which has hitherto been paid. We propose that that state of things, assuming that there is no disturbing element at work, shall continue for about three years, and we then hope that we shall be able to make a further reduction in the renewal fund. I hope I may count on the confidence of the shareholders in reference to this matter. I do not think it would be advisable to state here in what respect we mean to make that economy. I trust that any discussion which takes place on this subject may be conducted with order, regularity, and, let me add, in conformity with the articles of association. The articles of association are sneered at, and we are told that they are hurled at the shareholders' heads but we cannot manage this company, or any business, without having rules for our management. It is in the power of the shareholders, and there is a prescribed mode in which those articles can be altered if they are opposed to the views of the shareholders generally. But sitting here as your chairman, and as the person by whom order is to be maintained, I should be acting illegally—and I would subject myself to legal control—if I did not see that these articles were enforced. I will detain you no longer but merely move that the report of the directors and the accompanying statement of accounts be, and the same are hereby received and adopted.

The Marquis of Tweeddale seconded.

Mr. Thomas Smith, of York, moved, "That no further addition to the so-called renewal fund shall be made from the 1st of August, with the exception of the accruing interest." To some extent, he said, the directors had admitted since the last meeting the fairness of this resolution. When they took into consideration that at the end of the present half-year the renewal fund would represent the very large sum of over £800,000, they must also take into consideration the distress and suffering of the smaller shareholders at this crisis in business, who had only received the beggarly pittance of 10s. per cent. on the ordinary stock, and 20s. per cent. on the preferred for the past half-year, whilst the directors had added to the renewal fund £62,322 16s. 3d., or nearly twice as much as they had given the shareholders. He had had a great many letters from shareholders from all parts of the country complaining bitterly of this action of the directors. It was all very well to provide for the future, and he thought, whatever anyone else might say, that they had more than done their duty in that respect. They had, since 1880, taken from the honestly earned dividends £1,400,000; £600,000 of this had been paid the Telegraph Construction Company, and he supposed the remaining £800,000 was awaiting the convenience of the directors to be also handed over to that company. There was no necessity for any further addition to that £800,000, for if they required two new cables and put up the contract for public competition they would get them both for less than £800,000. A large contractor had assured him of this. As the shore ends of the cables would be as good as ever, it would only be the mid-ocean portions that would require renewal. He gave them notice that he should require to know at the next meeting the total amount they had paid to the Telegraph Construction and Maintenance Company since they had been directors. He, and those who were acting with him, had procured a large number of proxies, and had taken them to the office, but they were refused because they were a few hours too late.

Mr. Sealey seconded Mr. Smith's motion, remarking that the Anglo-American Company seemed to be a nursery for all the other companies.

Mr. Stockdale supported the amendment, and asserted that the present market value of the holdings of five of the directors was not more than £2,400; these five formed the majority of the board, and it was unjust that they, with such little interest in it, should control such a vast property.

Mr. Jackson and Mr. Griffith having also condemned the policy of the board,

Mr. Burton said he could not agree with the amendment, because he regarded it as essentially a vote of censure on the board, though it was not expressly so. It implied either that the directors were not men of business, and therefore not capable of conducting the company, or otherwise that they were actuated by self-interest. He did not believe either the one suggestion or the other. Believing that the board, from long experience, their well-known character, and the opportunities they had had of viewing the question from all points, were better able to judge what was for the interest of the company than Messrs. Smith and Company, he should support them.

Mr. Prust spoke in similar terms, and afterwards offered an ample apology for the course adopted by him and others, under a misapprehension, at the last meeting, with regard to Mr. Cyrus Field. He was quite satisfied that the charges brought against Mr. Field were utterly unfounded.

Mr. Newton also apologised to Mr. Field, and after several other shareholders had spoken,

Mr. Field said: I beg to return my sincere and grateful thanks to Lord Monck, Mr. Weaver, and the 1,068 shareholders who supported me, against a minority of three on February 6th, for the confidence they expressed in me—the first two by their speeches, and the rest by their votes. Their esteem I value so highly that I should deeply regret if any of them had attached the slightest credence to the voice of misrepresentation and calumny which was so unexpectedly raised against me in my absence. I think it necessary to make only a few more remarks. Probably a good deal of the excitement which prevailed at the last meeting was due to the smallness of the profits divisible among the shareholders. I would remind those who are dissatisfied with the position of the company that the directors have not made that position, but are the victims of circumstances beyond their control. They should remember that the successful laying of our two cables in 1866 unfortunately produced an exaggerated idea as to the profits which the undertaking might be made to yield. This has led to a too keen competition, which in its turn has naturally borne fruit in fluctuating tariffs and diminished dividends; but the fault of this untoward state of things assuredly does not lie at the door of the directors who, I firmly believe, have done all in their power to administer the affairs of the company with efficiency and success. I do value very greatly the opinion of my English friends (among whom are many of the best friends I have in the world), and desire to keep what I have

gained in over 30 years—their confidence and their respect. The Anglo-American has four cables, and pools its receipts with four belonging to other companies. Three of its cables are landed in Newfoundland, and one at St. Pierre near the coast of that island, and on February 6th (the day of this meeting of shareholders) they were the only ones that were working. The other four were all broken. Two have since been repaired, but two still remain useless The Mackay-Bennett cables were both broken soon after they were laid. Thus, of the ten Atlantic cables, every one has been broken within the past year except those of the Anglo-American Company landed in Newfoundland. Could anything show more conclusively that a cable laid direct from Ireland to Newfoundland, across the great telegraphic plateau, is much more likely to be kept in working order than a longer line traversing other parts of the ocean? Where would your company be now if it had no connection with Newfoundland, and had been obliged to seek a landing on some more distant point of the American coast? Yet you could not have touched Newfoundland without the consent of our company which had an exclusive right for 50 years to land cables on that island. Sir James Anderson, who has had great experience in the landing of cables in different parts of the world, can tell you what he considers these exclusive rights are worth to the Anglo-American Company. In conclusion, I read the following extract from a letter to the secretary from Mr. William Abbott:—"Under these circumstances it affords me pleasure to withdraw the statements which I made at the last meeting of the Anglo-American Telegraph Company, and to express my sincere regret that Mr. Field should have experienced pain or annoyance from what occurred through the action which I took, as I considered, in the interests of the stockholders of that company."

Mr. Abbott admitted that he had been misled, and said he was now quite satisfied that Mr. Field had no connection with the Wabash Railway scheme, which had been the cause of ruin to many homes in England, and also that he had nothing to do with any undertaking whose interests were inimical to those of this company. Therefore it would be most ungenerous and un-English if he did not at once acknowledge that he was in error, and apologize to Mr. Field. Mr. Abbott then spoke of the great security and strength imparted to the company by the renewal fund, which some of the shareholders disapproved of.

The Chairman, replying to the remarks made by shareholders, said there were two general propositions which had been stated, and to which he assented with the greatest pleasure. One was that the board had no desire to quarrel with the shareholders because they criticised their proceeding. It had been asked, what was the use of a general meeting? The use of a general meeting, as it appeared to him, was to give the directors of a company an opportunity to ascertain the general feeling of the proprietors, to enable them so to qualify their views as to meet as far as possible the views of the proprietors generally. The other proposition was that, as suggested by Mr. Abbott, shareholders were beginning to look after their own interests. He was delighted to hear this; nothing gave him more pleasure. On the other hand, he must protest against the idea that directors were not to direct. If they did not conceive that their directors were managing their affairs on proper principles, or if they had not confidence in their integrity and honesty, why, turn them out. But he did not think it right when directors came before them with a full, candid declaration of their policy, and the reasons for it, and when they showed that they were acting strictly in accordance with the articles of association, it was not fair to say that they muzzled the shareholders. The question of the renewal fund had been discussed over and over again, and he had not heard a single remark respecting it to-day which he had not heard before. They had fully answered everything that had been said, and he hoped gentlemen would not consider him disrespectful if he did not take up their time by going into the matter in detail again.

Mr. Smith's resolution having been ruled out of order, the original motion was put, and the adoption of the report was declared carried.

Mr. Smith consented to the resolution moved by him being put in the form of a recommendation to the directors, whereupon the meeting voted—29 for the recommendation and 26 against it.

Mr. Chester also submitted a recommendation to the directors, to the effect that no contract for a new cable should be entered into by the board without first obtaining the consent of the shareholders in general meeting assembled. This was seconded and put to the meeting, when 29 voted for and 18 against it.

The directors claimed a poll upon each of these recommendations, which it was arranged to take immediately upon the termination of the meeting.

Mr. Smith stated that the directors might save themselves the trouble of going to a poll, which was only a farce. They would only have their own votes and the proxies which they themselves held to record.

Submarine Telegraph Company, Limited.

THE half-yearly general meeting of this company was held at the offices of the company, 2, Throgmorton Avenue, London Wall, on Tuesday, under the presidency of Sir Julian Goldsmid, Bart., M.P.

Mr. S. M. Clare, the secretary, having read the notice convening the meeting,

The Chairman said: You will observe by the report that the receipts amounted to £66,000, which enables us to add the usual 10 per cent. to reserve and pay 15 per cent. to our shareholders, which leaves a balance of £989. That gives us a considerable increase upon the corresponding period of last year, and, of course, you can easily understand that the troubles in the East, and the change of Government and various other circumstances, have led to a considerable increase of telegraphing between this country and the Continent, and that result is shown in the figures we put before you to-day. I do not like to mislead you, and I cannot myself think that there is a permanent increase of traffic sufficient to give us a permanent increase of income, for, as far as my experience goes, you have these fits and starts in telegraphy, just as in other branches of trade, and I do not see that improvement in business which leads one to think that we shall have a great increase in telegraphy. In the half-year ending June, 1884, 1,377,419 messages were received, these containing 16,583,147 words, being, therefore, of an average length of 12·04 words. During the same period of the present year the total number of messages was 1,462,430, showing an increase of about 85,000, the number of words being 17,134,855, or an average of 11·02. Therefore, you perceive, the average length of the messages is continuing to decrease; and I find that during the month of July, the first month of the half-year just commenced, there is a still further decrease, so that we have not yet got to the bottom of the decrease in the average length of messages, which, of course, considerably affects our profits. There is one thing very satisfactory, and that is the condition of the cables. You will remember that I have stated on more than one occasion that it has been for a long time my duty to press the Government to make some arrangement with regard to the Dutch cable. After a great deal of work and considerable delay, I at last induced the Government to take the matter in hand. They have replaced one rotten cable altogether, and during the past winter they have put in 30 miles of new cable in the other. There are no longer any complaints, and, while this is satisfactory to the commercial classes, it is still more so to us, for we had to spend £2,000 less in the half-year for cable repairs than in the corresponding half of last year. There is one thing in which there is an increase of expenditure, which I do not think is altogether a matter of regret. We established some years ago a scale of increase in the wages of our telegraph and other clerks, who have from time to time, by length of service, risen to higher scales. We have constantly the desire to look after economy as far as possible, but there are some things entirely beyond our control, and, as I have said before, it is entirely beyond our control whether the public adopt that system of packing messages to which I have referred on previous occasions. I have to move that the report and accounts for the half-year be received and adopted.

The Hon. Ashley Ponsonby seconded, and the motion was carried.

The Chairman then moved, "That in accordance with the recommendation of the directors a dividend for the half-year ending June 30th, 1885, at the rate of 15 per cent. per annum, less income-tax, be declared and become payable from September 1st next."

Mr. Robert Bourke, M.P., seconded, and this also was agreed to.

The retiring directors, Mr. Robert Bourke, M.P., and the Hon. E. Chandos Leigh, Q.C., and the auditors, Sir Thomas Dakin and Mr. William R. Cole, were re-elected, the meeting thereupon terminating.

Edison and Swan United Electric Light Company, Limited.

THE annual general meeting of the shareholders of this company was held at the Holborn Viaduct Hotel, on Friday, July 31st, under the presidency of Mr. J. S. Forbes.

The notice convening the meeting having been read,

The Chairman said the anticipations he had stated at the last meeting, that they hoped to be able this year to report an improvement in the affairs of the company, had been realised. Their business was now so well organised that the directors were able to call the shareholders together in July instead of in December. During the past year they had transformed a loss of £28,000 to a net profit of £12,000, so that there was a difference of about £40,000 in favour of their present position. They had determined to abandon the Newcastle factory, as the buildings were very risky, and involved the payment of a very high premium; and premises in every way suited to their requirements had been found in the neighbourhood of London. The installations which the company had been carrying out during the past year, had resulted in a profit, and there were indications that the number of installations would be increased during the coming autumn and winter. The directors had determined to close as soon as possible those rental installations which they still retained, and to take none further of a similar character. Owing to the influence of vestrymen and others, such conditions and obstructions had been placed on electric lighting by the Board of Trade, that there was not one central station for electric lighting in London; nor was there likely to be, for he could not imagine any body of men being so entirely devoid of common sense as to go in for electric lighting under the existing Act. A deputation had waited upon the late president of the Board of Trade on the subject, and he believed they had convinced Mr. Chamberlain that the Act wanted a great deal of modification. Until it was greatly modified there would be very little done in the way of electric lighting. The result of the year's working had been a profit of £12,000, which the board advised the shareholders to carry forward to the reserve fund. He moved the adoption of the report and accounts.

Mr. Leyland seconded, and the motion was carried.

The Chairman stated, in reply to Mr. Addison, that the amalgamation of the two companies had now been carried out.

In the course of some discussion, it was asked whether the installation at Victoria Station had answered, and whether there was any probability of the Chatham and Dover Railway Company taking it over.

Mr. Leyland replied that the installation at present had not come up to their expectations, but he believed that improvements were being effected. When they were carried out some arrangement might possibly be made with the Chatham and Dover directors. The installation was very expensive, and, as far as they could at present see, he did not anticipate that it would be a very great success commercially.

This terminated the proceedings.

The Anglo-American Brush Electric Light Corporation, Limited.

THE Secretary, Mr. E. Garcke, has forwarded to the shareholders the following interim report of the work of the company since the last general meeting:—

Nearly six months having elapsed since the last general meeting, the directors feel it will be a satisfaction to the proprietors to learn that business continues steadily to improve, and that there is substantial evidence that the high quality of the electrical apparatus manufactured by the corporation is now fully recognised and appreciated.

The business effected during the past half year compares favourably with the result of the operations during the corresponding period of last year, and the present position of finance would enable the payment of an interim dividend. The experience in past years shows, however, that there is some degree of uncertainty as to the maintenance of the same average volume of business during the autumn months, and the directors have decided, after careful consideration, that the interests of the shareholders will be best served by carrying forward the profits realised on the working of the last half year, rather than by the payment of an interim dividend to take up a position which might lead to disappointment when the accounts of the whole year come finally under review and adjustment.

It is much to be regretted that the Electric Lighting Act of 1882, which has so greatly impeded the progress of electric lighting, is still unamended. The recent change of Government has interrupted the negotiations, which had been initiated with much care and consideration, with the view of obtaining an early amendment of the Act, and it is not probable that anything can be done until after the general election. The matter, however, is receiving the constant attention of your board and of the committee of experts and representatives of the leading companies formed to watch over electric lighting interests, and to confer from time to time with the Board of Trade. It is now generally admitted that considerable modifications in the Act are required both in the interests of the public who desire the light, but are unable to obtain it under the existing repressive restrictions, and of those whose business it is to make such supply a commercial possibility. Sufficient proof has now been afforded of the practicability and advantages of the electric light, and the outlook may be considered as most encouraging so soon as the more equitable conditions, which must be eventually conceded by Parliament, have been established.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of July was 3,058, estimated to produce £2,500, against 3,596 messages, producing £3,219 in the corresponding month of last year. The receipts for the month of April, estimated at £3,700, realised £3,886.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 31st, were £2,124, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st July, are £2,560, as compared with £2,791 in the corresponding period of 1884.

The Great Northern Telegraph Company. The receipts for July, 1885, £25,200; from January 1st to July 31st, 1885, £168,040; for the corresponding months of 1884, £155,880; and of 1883, £145,640.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of July were £1,200, against £1,501 in the corresponding period of last year.

NEW PATENTS—1885.

*8270. "Electric bell indicator." E. THURKLE. Dated July 8.

*8455. "Electric bells." H. J., E. J. DALE, A. NEWMAN. Dated July 13.

8881. "Secondary and primary batteries." W. P. THOMPSON. (Communicated by E. Julien.) Dated July 23.

* Omitted in previous lists through insufficient indexing in books of Patent Office.

8895. "Electric pilot for navigable vessels." H. C. BULL. Dated July 23.

8905. "Fire alarm signalling apparatus." E. W. BECKINGSALE. Dated July 23.

8909. "Making carbons of incandescence electric lamps." F. WYNNE, L. S. POWELL. Dated July 23.

8923. "Measuring electric currents." A. G. BROOKES. (Communicated by J. L. Huber.) Dated July 23.

8949. "Apparatus for producing electricity on board ships and the application of the same to their propulsion." J. M. PATES. (Communicated by H. W. Cook.) Dated July 24.

8962. "Construction and arrangement of primary electrical batteries." C. D. BARKER. Dated July 24.

8987. "Galvanic plant invigorator and oxygeniser." R. G. OWEN. Dated July 25.

8995. "Electro-magnetic type setting engine." W. DREYER. Dated July 25. (*Complete.*)

9029. "Electric arc lamps." A. F. LINK. (Communicated by L. Scharnweber.) Dated July 27.

9036. "Fire alarm." G. F. REDFERN. (Communicated by A. Bruyneel.) Dated July 27.

9054. "Electric table lamps applicable also to domestic electric lighting." R. H. COURTENAY. Dated July 28.

9064. "Regulators for electric arc lamps." H. J. HADDAN. (Communicated by H. Henneberg and R. O. Lorenz.) Dated July 28. (*Complete.*)

9079. "Automatic electrically operated steering gear." R. D. BOWMAN. Dated July 28.

9085 "Secondary voltaic batteries." O. IMRAY. (Communicated by A. W. Hemp.) Dated July 28.

9089. "Gas batteries for the production of electric currents." F. L. HARRIS. Dated July 28.

9107. "Separators and separating material for secondary batteries." T. PARKER. Dated July 29.

9108. "Electric air pump." S. C. C. CURRIE, I. A. TIMMIS. Dated July 29.

9128. "Annunciators or indicators for domestic purposes." J. S. SLEDGE, A. SLATTER. Dated July 29.

9134. "Completing or closing electric circuits." E. WOOD. Dated July 30.

9143. "Telephonic transmitter." E. G. COLTON. Dated July 30.

9158. "Electric motor." J. B. DENIS. Dated July 30.

9164. "Compasses and binnacles." B. RUSS. Dated July 30.

9183. "Electrical motors." R. HOWARTH. Dated July 31.

9199. "Electric arc lamps." H. J. HADDAN. (Communicated by R. and B. H. Walther.) Dated July 31.

9212. "Telephone transmitters." E. C. PARKER. Dated July 31.

9213. "Taking up slack in wires operating railway signals and apparatus from a distance." J. COLEMAN, O. HENSON. Dated July 31.

9217. "Boxes or cells for electrical batteries, &c." W. H. QUARTERMAN. Dated July 31.

9274. "Telephonic transmitters." R. H. RIDOUT. Dated August 4.

9281. "Vacuum lamps." W. P. THOMPSON. (Communicated by H. Wellington.) Dated August 4.

9293. "Transmitting audible signals by electricity." A. F. ST. GEORGE, H. J. BRISCOE. Dated August 4.

9295. "Electric scratching board for horse and other races or contests." T. HAYDON, T. GAUNT. Dated August 4.

9302. "Gas batteries." A. R. UPWARD, C. W. PRIDHAM. Dated August 4.

9325. "Regulating devices for electric lamps." W. LAHMEYER. Dated August 4.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

2960. "Improvements in appliances for electrically controlling and regulating the speed of motors employed for driving dynamo-electric machines." C. J. BOSANQUET and W. A. TOMLINSON. Dated March 6. 6d. In figs. 1 and 2, *a* is a horizontal shaft, from which the governor is driven, and *b*, the driving pulley. The shaft, *a*, terminates in a bevel wheel, *c*, which gears with a similar wheel, *d*, this latter wheel being loose upon its spindle serves to transmit motion through a third wheel, *e*, which is also loose upon its spindle, to a fourth wheel, *f*, keyed to the brake disc spindle, *g*. The axis upon which the wheel, *e*, turns, is so mounted that it is capable of angular motion, and thus can travel round between wheels, *d* and *f*, through part of a circle, moving the valve with it. The solenoid, *h*, may be placed upon top of the apparatus, and the core, *i*, of the same, acts through the levers, *k*, *l*,

upon the saddle piece, *m*, which stands upon the friction disc, *n*, placed upon a fixed steel surface, *o*. As the core, *i*, is drawn up by the action of the current, the levers, *k*, *l*, transmit a highly increased pressure upon saddle piece, *m*, forcing it upon friction disc, *n*, and augmenting the power required to drive same. This power passes through the four bevel wheels, the axis of one of which, *e*, is capable of motion against the spring, *p*. When the power transmitted through the wheels is increased, the wheel, *e*, is carried round until the tension of the spring balances the

FIG. 1.

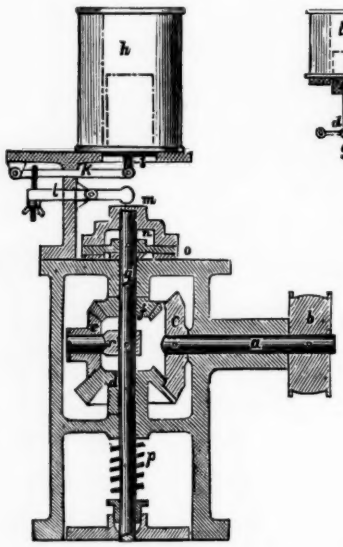
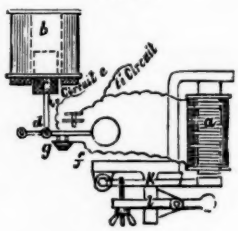


FIG. 2.



greater strain upon the teeth of the wheels, and will remain in that position while the current is constant. The connection between the travelling wheel and valve is made by fixing their spindles together, which may be done, as shown, by pin, *r*. Fig, 2 shows a solenoid and magnet for working the arrangement of the regulator as described. The spring is here used to close the valve. Upon the current breaking, the spring, *p*, shown in fig. 1, instantly closes the valve and stops the engine. The magnet, *a*, in fig. 2, takes the position of the solenoid, *h*, in fig. 1, and produces friction through the levers, *k*, *l*. The current is varied in magnet, *a*, by the solenoid, *b*, as follows:—A small portion of the current from dynamo flows through the solenoid, *b*, the strength of which varies upon the lights being turned on or off, the core, *c*, moves the levers, *d*, and regulates the supply of current to the magnet, *a*. In the normal position a given amount of current excites the magnet, *a*, through the wires, *e* and *f*, and the cup of mercury (or other variable resistance), *g*, producing friction through the levers, *k*, *l*, on the friction disc, *n*, as described with reference to fig. 1. When the current falls below the normal, the solenoid, *b*, allows more current to pass through the resistance, *g*, producing more friction on disc, *n*. Should the current rise excessively, that through the magnet, *a*, is short circuited by the solenoid lever, *d*, touching the contact, *h*. No sparking is caused, as the current is not broken, but only diverted.

3120. "Improvement in electrotype shells and bases." G. W. CUMMINGS and J. R. CUMMINGS. Dated March 10. 4d. Relates to the means for securing electrotype shells to bases or blocks; and it is especially adapted for use in the publishing of newspapers which heretofore have had their printing matter sent them from a distance in the form of stereotype plates. The character of the plate or shell to which the improvement is particularly applicable, is an electro-shell having its edges extending out beyond the boundary of the printing surface to form flanges adapted to be turned downward over the edges of the base or block.

3505. "Improvements in electric cartridges." S. RUSSELL. Dated October 22. 4d. The cartridge is constructed with a small electric conductor of high resistance, usually a fine platinum wire, arranged in contact with the powder, which conductor, upon the passage through it of a sufficient electric current, is heated to incandescence and ignites the powder. This invention consists in certain improvements in the construction of the cartridge.

3592. "Improvements in electric bells." P. JOLIN. Dated March 20. 6d. Relates to the apparatus described in the No. of the REVIEW for May 30th, 1885.

3789. "Improvements in electrical signalling apparatus for hotel and analogous purposes." B. J. B. MILLS. (Communicated from abroad by F. E. Lyster and G. J. Schermerhorn, both of New York.) Dated March 24. 6d. The object of the invention is to place in each guest's room an instrument whereby he can at pleasure signal to the hotel clerk his various "wants," and in so combining and connecting the various instruments with means for releasing them and receiving the signal controlled by the hotel clerk or receiving person, that if desired the mere act of setting any guest's instrument automatically operates an annunciator at the receiving end, so as to inform the clerk that the particular instrument has been set, and that thereupon this clerk, as soon as prepared to receive the signal, can by making certain connections introduce a receiving instrument, release the guest's signal instrument, and thus receive the guest's signal at pleasure.

3813. "Improvement in electric signalling apparatus." F. B. HERZOG. Dated March 24. 6d. The object of the present invention is, first, to provide a signal transmitter, so constructed as to have a great capacity to transmit signals for many uses to which it is applicable, more especially for use in telephone exchanges, so that it can be readily set by any unskilled person to transmit various combinations of impulses or signals to enable the sender to transmit numbers containing units, tens, and hundreds, for example, and which shall be reliable in its operation, and very simple and cheap in construction. In its use in telephone exchanges it serves general purposes. The first is: it is particularly intended to enable the telephone subscriber before leaving his office to set the apparatus so that a calling subscriber may be automatically informed, not only of the hour and minute of his intended return, or of a number representing in a code the place to which he has gone, but may be informed at the same time of both of these sets of information. The second purpose for which instruments of great capacity are to be used is to enable subscribers to indicate by the instrument the number of another subscriber with whom they wish to speak, and having set it at this number, to have it remain as set until it is released by the central operator, when it will transmit the desired signal without any further need of oral communication between calling subscriber and operator.

CORRESPONDENCE.

Aerial Electrical Signalling Apparatus.

In these days of electrical advancement it seems only necessary for a man to appear before the public with some invention bearing a seemingly original stamp upon it, to have another man or more, rush forward with the intelligence that "he did it long before," and however unwelcome the statement may be or how untruthful he may think it, I would tell Mr. Micklewright, whose "aerial electric signalling apparatus" was illustrated in the REVIEW of July 11th, 1885, that I claim to be the originator of a method of signalling from war balloons, by means of incandescent lamps, and have drawings showing in detail the arrangement of balloons, coloured lamps (incandescent) reflectors, cables, windlass, switch and key board and arrangement for either dynamo or batteries (primary or secondary); the original of these date back as far as the fall of 1879. My first suggestion of such an arrangement was due to an experiment tried in Edison's laboratory at Menlo Park. I placed an Edison lamp inside a large glass globe which was surrounded by another globe of twice the size, the space between being filled with crimson analine solution; this rested on my table at one of the windows, and by means of a telegraph key inserted in the lamp circuit I could flash coloured signals to the telegraph operator at the Pennsylvania Railroad Station, one-eighth of a mile away. This suggested my balloon signalling, which at that time I sketched roughly out, and have since much elaborated, until I consider myself not only the originator of the idea, but the originator of the best means of accomplishing this admirable means of signalling either at sea or land during times of war or peace.

Wm. J. Hammer.

New York, *July* 21*st*, 1885.

The Martin Switch.

Referring to your remark on page 106 of last number of ELECTRICAL REVIEW, that "a precisely similar apparatus" (to the "Martin Switch") "has been for some time in use as an electric bell pull," I may say, to prevent misconception, that the bell pull mentioned is also made by Mr. Martin. The slight alteration which makes it a very effective switch was made recently at my suggestion.

C. R. Heap.

London, E.C., *August* 5*th*, 1885.